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ENTOMOLOGICAL REVIEW

(Entomologicheskoe Obozrenie)

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ENTOMOLOGICAL REVIEW

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AN ACCOUNT OF THE ACTIVITY OF THE ALL-UNION ENTOMOLOGICAL SOCIETY FOR THE PERIOD 1859-1959*

G. Ya. Bei-Bienko

Translated from Éntomologicheskoe Obozreinie Vol. 39, No. 1, pp. 5-33, January-March, 1960

INTRODUCTION

Present-day entomology is a broad complex of scientific disciplines embracing general, agricultural, forest, medical, and veterinary entomology, with apiculture and sericulture forming closely allied branches. These sciences provide man with a knowledge of the laws of living nature, and assist in raising the productivity of agriculture and forestry, and in the struggle for the health of mankind.

A typical feature of the present stage of development of entomology is the extraordinarily broad scope of its investigations. This is seen, first of all, in the number of published works. Throughout the world at present, more than four thousand works are published every year, i.e., at least 11 per day; in 1955 the total number of entomological papers, books, and other editions published during he history of mankind reached the enormous figure of more than 200 thousand titles. Such is the contribution of entomology to world culture.

Another feature is the differentiation within the entomological disciplines themselves. In general entomology there have been created such major divisions as insect morphology, physiology, ecology, taxonomy, and paleontology, which are now generally the subject of independent specialties. Each of these in turn is composed of several subdivisions, a good illustration being insect taxonomy where we have extremely ramified specialization—for orders, suborders, and even for families. Such marked specialization is characteristic also of several of the applied entomological disciplines; for instance, in agricultural entomology there are already clear subdivisions for specialized groups of pests of field crops, vegetables, and fruit crops; other major divisions have also sprung up, such as chemical protection of plants and biological control of pests.

This unusually broad scientific advance of present-day entomology is due to the specific nature of the object of research—the class Insecta. The insects constitute a gigantic assembly of organisms, astounding us by their infinite diversity of form, biological characteristics, and adaptive features; they also have a tremendous influence on natural processes and on mankind. We know that there exist more species of insects than of all other animals and plants taken together; in the Soviet Union alone the number of species is atleast 80 thousand.

The high degree of specialization and the great scope of present-day entomology are furthered still more by the fact that acarology, the study of another very important branch of the terrestrial arthropods— the mites and ticks is a very closely related field as regards scientific problems and investigational methods. The great diversity and considerable importance of this group of organisms is becoming more and more evident; in many cases they repeat the life forms, adaptive features and match the economic importance of insects. The common nature of the scientific interests of the entomologist and acarologist in agricultural, forestry, medicinal and veterinary entomology is very apparent.

Such is the state of present-day entomology and hence the mastery of all its diverse disciplines and their divisions is possible only for large and versatile groups of specialists. Such a group is the All-Union Entomological Society, and in this resides its great cultural role and its national importance.

The Founding of our Entomological Society

The birth of scientific entomology was due to the necessity for finding control measures against pests and to the eternal quest of man for knowledge. However, the emergence of entomology as a special branch of knowledge only became possible with the development of science and culture; the beginning of the 19th century can be regarded as the time when scientific entomology was born. The need arose for a society of persons interested in insects and in their research; thus there arose strong entomological societies, the oldest now in existence being the Société Entomologique de France, founded in 1832 , and the Royal Entomological Society of London, founded in 1833. Several other entomological societies were created later, and of these there still exist the Societe Royal d'Entomologie of Belgique (1855), the Deutsche Entomologische Gesellschaft (1857), the Schweizeriche Entomologische Gesellschaft (1858), the American Entomological Society (1860), and others.

* Delivered at the Fourth Congress of the All-Union Entomological Society in Leningrad, January 26, 1960.

The idea of forming an entomological society in our country arose as early as 1846-1847. In St. Petersburg at this time, an amateur entomologist, Col. A. K. Mandershtern, and a teacher Yu. I. Simashko, the well-known author of "Russian Fauna", organized a small private circle of 30 persons interested in entomology; they sometimes assembled at the apartment of one of the members. By 1848 the idea of organizing an entomological society was fully formulated and a constitution was already outlined, but no further steps were taken. According to Simashko, the question of the founding of the society was the subject of a prolonged debate at one of the meetings of the entomological circle in April 1848, and the majority of its members "considered it better to await a more favorable time," particularly in view of the fact that "in spring, entomologists from the army were going on a campaign to the western limits of the Empire". Apart from these quoted words we have practically no other published information or minutes on the main reason for the delay of more than ten years in founding our society. There actually were many soldiers in the composition of the circle and they did in fact "go on a campain to the western limits of the Empire". But this was not the main reason. The year 1848 was one of violent revolutionary activity affecting a considerable part of Europe and coinciding with the period of the Nikolaev reaction. "In the circumstances of this time it was not only necessary to shelve this project (i.e. the founding of the Society— G. B.-B.) for a long time, but even to stop the private meetings", wrote G. G. Yakobson more then 60 years after these events. The interpretation now put on this is that the development of entomology in our country was held up for reasons which it was impossible to speak openly about at that time.

It was not until March 9 (February 25 by the old calendar) 1859, that a group of 33 persons met in Mandershtern's apartment and elected a committee to draw up the constitution of the Russian Entomological Society and "a petition to the highest authority". The elected members included: Academician K. M. Baer, the celebrated naturalist of the 19th century; F. F. Brandt, the Director of the Zoological Museum of the Academy of Sciences; Junior Captain Ya. A. Kushakevich; Col. A. K. Mandershtern, the well-known traveler and explorer of Siberia ; Academician A. F. Middendorf; and Lieutenant-Colonel of the General Staff V. I. Mochul'skii, the eminent entomological taxonomist.

The constitution was approved on December 16 (4), 1859, and this marked the official birth of the Russian Entomological Society, the successor to which is the present All-Union Entomological Society. In fact, the starting date of its activity can be considered to be March 9 (Feb. 25) 1859, when there was a meeting of the working group which passed a resolution on the founding of the Society and elected a special committee to undertake the necessary work of organization. These events fix de facto and de jure the time of founding of our Society, in both cases, 1859.

The constitution of the Society clearly and distinctly defined its aims. They were set out in its first paragraph and consisted of five headings : "a) to promote the spread of entomological knowledge in Russia, b) to study articulated animals, particularly native ones; c) to undertake and to publish the results of research on the benefit and harm caused by them , and to find means of exterminating insect pests. d) to acclimatize useful insects. e) to bring Russian entomologists together and to foster their relations with societies of naturalists and with scientists abroad" . Hence, in this constitution it was clearly laid down that the aims were primarily the entomological study of our country and the establishment of links between science and practice. We should note, however, that this constitution rigidly and unambigously restricted the activity of the Society; paragraph 23 states that "theories, arguments, or proposals not relating to the natural sciences, will not be tolerated" (stressed in original), while Paragraph 24 states : Each member of the Society is allowed to bring one guest to a meeting". These items, imposed on the Society from above, illustrate the disregard for elementary democracy and the attempt to rule out any opportunity for the expression of progressive social ideas. The constitution was only a little better in 1864. Nevertheless, throughout the whole period of its activity, the Society constituted an assembly of people of advanced views, and lent its support to many progressive undertakings; we will have the opportunity to say more of this in the following account.

Initial Period of Activity of Society

The first official meeting of the Society was held on March 8 (February 25), 1860 in the Small Conference Hall of the Academy of Sciences in St. Petersburg. It was given over to organization, and Members of Council were elected : President — Academician K. M. Baer; Vice-President— A. K. Mandershtern; Secretaries — Yu. I. Simashko and É. F. Ménétriés; Treasurer — The merchant I. I. Sivers; and Curator — Ya. A. Kushakevich.

The 30 persons taking part in this meeting, together with five persons who happened to be absent, are regarded as the Founder Members. They were far from all being professional scientists or entomologist-explorers; most of them were amateur entomologists—doctors, civil servants, business men, and, in particular, soldiers.

Among the scholars and entomologist-explorers, apart from the already-mentioned Academician F. F. Brandt, Academician K. M. Baer, É. F. Ménétriés— Curator of the Zoological Museum of the Academy of Sciences, Academician A. F. Middendorf. V. I. Mochul'skii, and Yu. I. Simashko, the Founder Members included several other well-known names. We might mention F. P. Keppen, the well-known scholar, later Librarian of the Public Library (now the M. E. Saltykov-Schedrin Public Library)

and the author of the authoritative compilation "Injurious Insects" (1881-1883); F. F. Morawitz, the authority on Hymenoptera and bees, a doctor by profession; R. R. Osten-Sacken, a diplomat and specialist on Diptera; O. I. Radoszkowski, Colonel, later General, of the Horse Artillery and President of the Society; L. I. Schrenk, the well-known traveler, later Academician; and A. A. Shtraukh, a doctor, and later Academician and director of the Zoological Museum of the Academy of Sciences. To these names we should also add those of I. G. Voznesenskii, Curator of the Zoological Museum, and a student of the fauna of Northeast Asia and Western North America, and S. M. Sol'skii, an eminent specialist on Coleoptera, later Vice-president of the Society; during the first 50 years of existence of the Society, they were not numbered among the Founder Members for formal reasons, and it was not until 1909 that their services were accorded due recognition.

It is now with gratitude that we recall the names of the Founder Members, both the scholars and the modest amateur enthusiasts, who, united by a common love for nature and a desire to make their contribution to the national culture, were able to overcome the difficulties which arose and managed to create a scientific society, the country's need for which and the vitality of which have stood the test of time.

The first administrative meeting was followed by a second scientific meeting, which was held in the Small Conference Hall of the Academy of Sciences (now the University Embankment, 5) on May 22 (10), 1860. At this meeting, the President of the Society, K. M. Baer, gave a scheduled address, "The correct approach to living nature and its application to entomology". The extensive range of biological phenomena, the brilliant analysis of the interrelationships of organisms, the scientific accuracy combined with bold speculation, the relativity principle in the assessment of natural phenomena, and the idea of dialectic development, were the characteristic features of this outstanding paper, though it was not devoid of a certain measure of eclecticism.

"Every absence of motion is only apparent, and only constant change in form of development is actual and eternal" was the scientific-philosophical standpoint from which Academician Baer studied and regarded all natural phenomena. In appraising our views on these phenomena he pointed out "that if the measure of time inherent to us had been different, then it would be inevitable that external nature would appear different to us, shorter or longer in its manifestations, narrower or broader in its effects". With reference to entomology, he noted inter alia the importance of the study of larval forms: "...their relations with external nature are much closer than in the case of adults, and they are more deeply involved in the economy of nature than the delayed insects." This problem still confronts us today.

From the very beginning the main activity of the Society consisted of scientific meetings of its members with discussion of papers, advocating various measures and giving advice on questions of applied entomology, especially plant protection, the building up of its own science library and stock collections of insects, and the publication of results of research by its members.

Moreover, as one of the first scientific biological associations in the country, the Society in these far-off years fulfilled another essential role: It was a center of attraction for biologists in general, including even botanists.

The general unity was fostered also by the common interest invoked by one of the basic aims laid down at the foundation of the Society— the study of the natural history of St. Petersburg Province, for which a special committee had been set up. This was the beginning of the more systematic study of the fauna and flora of the Northwest of the country.

In 1864, there was published the volume "Natural History Investigations of St. Petersburg Province, Carried out by Members of the Russian Entomological Society" which was dedicated to the 50th anniversary of the scientific activity of its President— Academician K. M. Baer. This voluminous book contained several valuable works, such as K. F. Kessler's important study of fishes, A. O. Kovalevskii's first scientific work, devoted to the anatomy of the sea slater (Mesidotea entomon L.) and the crustacean fauna of the province, the papers of the eminent Russian botanist A. N. Baketov, on the vegetation of the province, and M. S. Voronin, on polymorphism in the fungi · Pyrenomycetes.

The botanical members of the Society formed the Botanical Section, and these included several well-known scientists: the above-mentioned A. N. Beketov and M. S. Voronin; G. S. Karelin, the celebrated investigator of the flora of the Southeast region of the country; A. S. Famintsyn, the eminent plant physiologist, later Academician; E. Pegel', director of the Botanical Garden of the Academy of Sciences; and others.

It was not until the founding of the Society of Naturalists in St. Petersburg University in 1869 (now the Leningrad Society of Naturalists), with both botanical and zoological sections, that the botanists and some of the zoologists went over to it, and since then the special entomological character of our Society has been maintained.

Composition of the Society and Some Information on Its History

At first the Society was an association of entomologists mainly from St. Petersburg, the capital at that time; in its first year of life it numbered 106 members. The membership subsequently increased in two ways: first, by the entry of entomologists from St. Petersburg—Leningrad, and second, by the entry of entomologists from other towns in the country, a trend which became more and more important. The course of this process can be seen from the following table:

	1860	1884	1909	1935	1959
Total number of members	106	202	338	390	1460
Members from St. Petersburg-Leningrad	72	104	129	180	178

Hence, within a hundred years the membership increased almost fifteenfold, and the Society now represents a powerful association of the country's entomologists.

The membership of the Society during this long period included many great scholars and public workers who have enriched science and culture by their scientific activities, as well as other things. Several names have been mentioned already, others will be named later, but here we must mention the leading workers in the Society and some of its outstanding members.

We should gratefully recall the names of its Presidents, Vice-Presidents, Scientific Secretaries, Editors of Publications, Librarians, Curators, Treasurers, and Council Members, whom the Society appointed to the task of directing its activities. To their energy, devotion to public duty, faith in the vitality and necessity of the Society, we owe the fact that it received the support of its members and did not wither away, but continued to flourish and to withstand the test of time.

One of the most difficult periods in the life of the Society was in its early years when, according to the words of Scientific Secretary L. A. Porshinskii in 1884, "the young Society, still representing a quite new feature in Russia, and left almost exclusively to its own resources, demanded great energy, work, and love on the part of its members, so that it could overcome the many obstacles and vicissitudes of various kinds". This was achieved by the great leadership of the first President — Academician K. M. Baer (1860-1861, 1863-1864), the connections of the first Vice-President — A. K. Mandershtern (1860-1861), the active and long service of the second Vice-President, later President — O. I. Radoszkowski (1861-1866, 1867-1879), and the devotion to duty of the first Scientific Secretary — Yu. L. Simashko (1860-1864). Even in this period, the Society managed to bring out a regular edition of its publication — "Trudy Éntomologicheskogo Obshchestva", which has been published since 1861.

In the following period, the Society increased in strength under the presidencies of Prof. E. K. Brandt (1880-1889), well known for his researches on the insect nervous system, and P. P. Semenov-Tyan-Shanskii (1890-1914), the celebrated explorer of Central Asia and an eminent public figure. Among other leading figures of the period prior to the October Revolution, we should make special note of F. F. Morawitz (Vice-President from 1867 to 1895, with but one break), S. M. Sol'skii (Scientific Secretary from 1869-1873, and Vice-President from 1875-1878), F. P. Keppen (Scientific Secretary 1865-1868, Vice-President 1897-1900), L. A. Porchinskii (Scientific Secretary 1874-1895, Vice-President 1896), L. Ya. Shevyrev (Scientific Secretary 1896-1908), A. P. Semenov-Tyan-Shanskii (Vice-President 1906-1914), G. G. Yakobson Scientific Secretary 1909-1917), and V. F. Oshanin (Vice-President 1914-1916). It is not only among entomologists that these names are widely known.

In 1904-1906 the Society undertook the publication of a periodical subscription journal "Russkoe Éntomologicheskoe Obozrenie," founded in 1901 by a special working group of members (D. K. Glazunov, N. P. Kokuev, N. Ya. Kuznetsov, A. P. Semenov-Tyan-Shanskii, T. S. Chicherin, N. N. Shiryaev, and A. N. Yakovlev). This journal, under the title "Éntomologicheskoe Obozrenie", is now the Society's main publication (by the end of 1959, 38 volumes had been published).

In 1904, the P. P. Semenov-Tyan-Shanskii Prizes were inaugurated by the Society to encourage scientific work in the sphere of entomology. These prizes were awarded nine times between 1905 and 1930, viz.: to V. É Petersen for studies on the morphology of Lepidoptera (1905); to V. F. Oshanin for a catalog of Palaearctic Hemiptera (1908); to É. F. Poyarkov for histological studies of metamorphosis (1911); to G. G. Yakobson for the authoritative work "Beetles of Russia and Western Europe" (1915); to V. F. Boldyrev for a series of works on the biology of Orthoptera (1917); to N. Ya. Kuznetsov for work on Lepidoptera in the series "Fauna of Russia" (1920); to A. K. Mordvilko for a similar work on aphids (1924); to A. V. Martynov for a series of works on the morphology of the insect wing and on Trichoptera (1927); and to A. S. Skorikov for work on the hive bee and bumble-bees (1930).

The period immediately after the October Revolution was a testing time. The Society, however, not only continued its work during the most difficult years, but even intensified it work by the organization of an Applied Entomology Section, which functioned during 1920-1930. It continued its publication of "Éntomologicheskoe Obozrenie", its library served both old members of the Society as well as the newcomers to its membership. Its scientific meetings continued to be a center of attraction for those interested in entomological questions, and its leaders gave full support to the new generation of Soviet entomologists. The Society took an active part in the All-Russian Entomo-Phytopathological Congresses (1918, 1920, 1921, 1922), which were succeeded in subsequent years (till 1932) by the All-Union Congresses on Plant Protection. During these years, these congresses played an important role in the discussion of various problems of plant protection and also in the creation of its new administrative structure. The many Society members who participated in the organization and work of the congresses included N. N. Bogdanov-Kat'kov, V. F. Boldyrev, L. V. Vasil'ev, N. Ya. Kuznetsov, N. M. Kulagin, N. F. Meier, A. K. Mordvilko, E. N. Pavlovskii, V. N. Pospelov, A. N. Reikhardt, M. N. Rimskii-Korsakov, A. P. Semenov-Tyan-Shanskii, V. N. Stark, V. N. Shchegolev, G. G. Yakobson,

and other eminent scholars who have made important contributions to the development of various branches of Soviet entomology.

During this period, the scientific meetings of the Society served as a platform for the prominent scientists among its members : N. Ya. Kuznetsov, A. V. Martynov, A. K. Mordvilko, E. N. Pavlovskii, M. N. Rimskii-Korsakov, and A. P. Semenov-Tyan-Shanskii, who created or prepared the scientific foundation of a number of theories and concepts in the spheres of morphology, taxonomy, classification, zoogeography, biology, and paleontology of insects and their roles as enemies of man.

N. Ya. Kuznetsov produced interesting work on the relation between the geographical distribution of insects and the distribution and chemistry of their food plants (published in 1930). Between 1918 and 1920 he set down a program and course of physiology of invertebrates in general, and of insects in particular, this being the initial stage of the work which led him many years later to the compilation of "Basic Insect Physiology", which was published after his death, in two volumes in 1948 and 1953, without the planned third volume.

In 1925, A. V. Martynov crowned his brilliant works on the morphology of the insect wing with the publication of his theory of two types, and proposed the subdivision of winged insects into two groups—the archaic Palaeoptera, and the progressive Neoptera, which flourished to an extraordinary extent. Not only did he carry out considerable research on the taxonomy and zoogeography of caddis flies, but also made a particularly intensive study of fossil insects and founded the Soviet school of Palaeoentomology the representatives of which at the present time are B. B. Rodendorf, O. M. Martynov, E. É. Bekker-Migdisova, A. G. Sharov, and others.

A. K. Mordvilko continued his remarkable researches on the morphology, biology, and systematics of aphids, and also gave papers at the Entomo-Phytopathological Congresses.

During this difficult time, the Society owed the continuation of its work and the maintenance of its important role in the development of the theory of general and applied entomology to the activity of many of its members and to the energy , unselfish devotion to public duty, and competence of its President— Prof. A. P. Semenov-Tyan-Shanskii (1914-1931), Vice-President— M. N. Rimskii-Korsakov (1917-1931), Scientific Secretaries —N. Ya. Kuznetsov (1918-1921) and A. M. D'yakonov (1922-1931), Council Members —G. G. Yakobson, V. V. Redikortsev, N. N. Bogdanov-Kat'kov, and others, and to its Scientific Librarian — A. N. Kirichenko (from 1915 to date).

During the period 1920-1931, the Society awarded three P. P. Semenov-Tyan-Shanskii prizes, as well as prizes named after V. F. Oshanin, and Honorary Member and Vice-President, inaugurated in 1917, to A. A. Balynitskii-Birul for a cycle of works on the morphology, taxonomy, and geography of scorpions (1922), to A. N. Kirichenko for works on Hemiptera (1926), and to E. N. Pavloskii for a monograph on poisonous animals (1931).

In 1931 E. N. Pavlovskii was elected President of the Society, A. P. Semenov-Tyan-Shanskii (1931-1942) was made Vice-President, and the Council was enlarged. The council at this time included A. N. Kirichenko, D. A. Ogloblin, V. P. Pospelov, A. N. Reikhardt, V. N. Shchegolev, N. N. Filip'ev, and others, while A. M. D'yakonov and V. N. Stark were elected Vice-Presidents. The next Vice-President was N. Ya. Kuznetsov (1933-1948), then M. N. Rimskii-Korsakov (1936-1950), elected as Honorary President (1950-1951) in his last year of life, Scientific Secretaries — N. N. Filip'ev (1932-1937) and A. M. Gerasimov (1938-1941), and Editor of Publications— A. N. Reikhardt (1932-1938). The council during this period continued its efforts to maintain the activity of the Society, and sought ways of linking science with practice and of assisting in the construction of the foundations of a socialist economy and culture. A new Constitution, corresponding to the time, was worked out, and this was approved by the People's Commissariat of Education in 1933 .

From the early thirties there was a greater emphasis on the experimental approach in the treatment of questions of the ecology and ecological physiology of insects. There appeared a series of works by I. D. Strel'nikov, on the body temperature and heat exchange in several serious pests— the migratory locust (Locusta migratoria L), the meadow moth (Loxostege sticticalis L.), and others. At the same time, I. V. Kozhanchikov began his numerous studies on the ecology and ecological physiology of insects, which continued for almost 30 years. These works laid the theoretical foundation for the understanding of several phenomena associated with mass outbreaks, behavior, and distribution of pests; the results of these investigations were the subject of discussion at the Society's meetings on many occassions.

In 1936 there appeared the outstanding work of A. P. Semenov-Tyan-Shanskii, the Honorary President of the Society— "The Boundaries and Zoogeographical Subdivisions of the Palaearctic Region" worked out on the basis of results on the distribution of Coleoptera. This embodied our knowledge of natural regions and the pattern of geographical distribution of insects in the USSR and neighboring countries, and its groundwork was laid down in the numerous addresses of its author at the Society's meetings. In 1935-1938, the well-substantiated works of the Vice-President N. Ya. Kuznetsov on the Arctic fauna and its origin, based mainly on a study of the Lepidoptera, were published; these works were a great contribution to our knowledge of the natural hisotry of Arctic Eurasia; some of the propositions were put before the Society as early as 1932.

An important event in the life of the Society was its affiliation in 1940 with the Academy of Sciences, USSR, this move having been suggested by the President, Academician E. N. Pavlovskii. By this act, the long period of

practical and scientific liaison of the Society with the Academy of Sciences as the highest scientific organization of the country was formally recognized. The Society has always drawn some of its members from the scientific institutions of the Academy, particularly in the last decade; within the precincts of the Academy, the Society found its first meeting place in 1860; prominent members of the Academy and scholars from its institutions have been elected to offices in the Society. In the period following the October Revolution, the Society worked in very close cooperation with the principal zoological institution of the Academy of Sciences, USSR—The Zoological Institute— and in 1919 the Society moved into this building and housed its library there too.

With the affiliation of the Society to the Academy of Sciences, USSR, a flourishing period of development was imminent, but the War of 1941-1945 dealt a heavy blow. The Society lost many members, including its Honorary President A. P. Semenov-Tyan-Shanskii, members of the older and middle generation of entomologists in the persons of É. F. Miram, D. A. Ogloblin, S. A. Predtechenskii, A. N. Reikhardt, N. N. Filip'ev and others, and many of the younger generation of entomologists in the full flower of their intellectual development— A. M. Gerasimov, F. K. Luk'yanovich, S. P. Tabrinskii, and many others. During the war the Society was kept alive in distant Stalinabad by its Council, who were preparing the soil for the restoration of its activity in the postwar period. In 1945, after a seven-year lapse, there appeared a very slim number of the "Éntomologicheskoe Obozrenie" (Vol. XXVIII, No. 1-2), a symbol of the incipient revival. We owe the resurgence of the Society at this period principally to the efforts of the President, Academician E. N. Pavlovskii, Vice-President A. A. Shtakel'berg (1942-1953), Scientific Librarian A. N. Kirichenko, and Scientific Secretaries V. V. Popov (1943-1944) and N. S. Borkhsenius (1944-1953).

The postwar period was characterized by an intensification of scientific research and other scientific activities of several Society members in the field of general entomological problems: The experimental ecological-physiological works of I. V. Kozhanchikov were continued; the studies of A. S. Danilevskii and his colleagues on photoperiodism in insects and of R. S. Ushatinskaya on cold tolerance were extended; the intensive research on the fauna, biology, and zoogeography of the insects of the Far East by A. I. Kurentsov, who was awarded the Stalin Prize in 1954, was continued; D. M. Shteinberg's works on insect hormones were published; the research on paleontology carried out by B. B. Rodendorf and his colleagues was intensified; O. M. Ivanova-Kazas completed a series of works on the comparative embryology of Hymenoptera, and these were acknowledged with an I. I. Mechnikov Academic Prize in 1958; M. S. Gilyarov's studies of soil as a habitat and its role in the evolution of insects were extended and were awarded a Stalin Prize in 1951; V. V. Popov produced an extensive cycle of works on the evolutionary systematics of bees; E. S. Smirnov completed a series of experimental researches on the adaptation of aphids to new food plants, and so on. The scientific results of many of the works in connection with the development of these lines of research were reported at the meetings of the society.

Major events were : the publication in 1948-1953 of the two volumes of "Principles of Insect Physiology" by N. Ya. Kuznetsov, and in 1949— B. N. Shvanvich's comprehensive work" A Course of General Entomology".

Substantial changes were made in the nature of the Society's work and in its organizational structure. From 1948, besides the usual scientific meetings, annual lectures in memory of Prof. N. A. Kholodkovskii, the eminent zoologist and entomologist, and Honorary Member of the Society, were inaugurated at the suggestion of the President, Academician E. N. Pavlovskii. At these lectures, papers on various problems of entomology and closely related branches of knowledge are read. The papers are then published in collections " The N. A. Kholodkovskii Memorial Lectures" (six such collections have been published since 1951).

In 1947 the Presidium of the Academy of Sciences, USSR, inaugurated the Prof. N. A. Kholodkovskii Prize to encourage works in the field of zoology and entomology. This prize has been awarded twice : posthumously to N. Ya. Kuznetsov in 1948 for the work "Lepidopterous Ambers" (1941) and to G. Ya. Bei-Bienko in 1951 for the work "Blattoidea" (1950) in the series "Fauna of the USSR" Since then, unfortunately, it has not been awarded; it is the Society's aim to have this prize reinstituted.

Beginning in 1950, a new form of activity was the holding of All-Union congresses and conferences, to provide for the practical cooperation and unity of its members, for discussion of the progress and aims of Soviet entomology, and for the establishment of democratic principles in the election of office-holders in the Society.

The first congress was held in Leningrad on February 15-18, 1950. In accordance with the new Constitution of 1947, this congress elected a larger Council, which included members from the central body , as well as a number of eminent workers from various parts of the country. From its own members, the Council elected a Presidium, which from that time has been the daily executive body of the Society. Academician E. N. Pavlovskii was reelected President. The Vice-Presidents were Prof. A. A. Shtakel'berg (reelection), Prof. E. V. Zverezomb-Zubovskii, and Prof. B. N. Shvanvich (1950-1957), and the Scientific Secretary was N. S. Borkhsenius. In 1953 there were changes in the composition of the Presidium: Owing to the illness of A. A. Shtakel'berg, G. Ya. Bei-Bienko was elected to the post of Vice-President, and O. L. Kryzhanovskii was coopted to the post of Scientific Secretary.

The increased membership in 1950 and, in particular, the increased number of entomologists in the provinces demanded a change in organizational structure — the

setting-up of Society Sections in the main centers of the country and in several of the Union republics. The Sections form local centers of the Society's work, and are delegated the necessary powers for developing initiative and for taking appropriate action in accordance with local conditions. At the present time there are 18 Sections, namely :

1) Moscow : President — Prof. D. M. Fedotov, Honorary Member of the Society, Honored Scientific Worker. Membership — 166 .

2) Siberian : President— Doctor of Biological Sciences A. I. Cherepanov. Membership — 101 .

3) Voronezh : President— Prof. P. A. Polozhentsev. Membership— 49.

4) Far Eastern : President — Prof. A. I. Kurentsov. Membership — 36 .

5) Rostov : President — Docent V. P. Romanova. Membership — 19 .

6) Ivanovo : President— Candidate of Biological Sciences N. I. Khelevin. Membership — 18 .

7) Sakhalin : Membership — 18 .

8) Sochi : President— Candidate of Agricultural Sciences K. M. Shishov. Membership — 11 .

9) Ukrainian : President — Active Member of the Academy of Agricultural Sciences, Ukr. SSR Prof. V. P. Vasil'ev. Membership — 225 .

10) Belorussian : President — Candidate of Agricultural Sciences T. T. Bezdenko. Membership — 42.

11) Uzbek : President— Corresponding Member of the Academy of Sciences Uzb. SSR Prof. V. V. Yakhontov. Membership — 108 .

12) Kazakh : President — Prof. S. A. Kharin. Membership — 51 .

13) Georgian : President — Prof. L. P. Kalandadze, Honorary Member of the Society, Acting Member of the Academy of Agricultural Sciences, Geo. SSR. Membership 103 .

14) Azerbaijan : In the stage of organization. Membership — 23 .

15) Moldavian : President — Prof. Ya. I. Prints. Membership — 41 .

16) Latvian : President— Prof. E. Ya. Ozols. Membership 31 .

17) Kirgizian : Membership — 23 .

18) Turkmenian : President — Candidate of Biological Sciences A. N. Luppova. Membership — 31 .

With the formation of the Sections, the Society has become a great country-wide association of entomologists, the functioning of which is based on the principle of democratic centralism. However, we cannot fail to remark that not all the Sections act with due initiative and energy, and some of them require a strengthening of their administration and a stimulation of their activity.

The Second All-Union Conference of the Society was held in Leningrad in 1954 and was devoted to a discussion of the main problems and aims of Soviet entomology; the results of this conference were set forth in a published resolution laying down a program of work, which is still valid for the present time. The following were elected to the presidium of the Council : President— Academician E. N. Pavlovskii; Vice-Presidents — G. Ya. Bei-Bienko, E. V. Zverezomb-Zubovskii, and B. N. Shvanvich; Members — A. N. Kirichenko, V. V. Popov, M. E. Ter-Minasyan, A. A. Shtakel'berg, D. M. Shteinberg, and E. M. Shumakov; Scientific Secretary O. L. Kryzhenovskii; and Treasurer — D. I. Blagoveshchenskii.

On the suggestion of the delegation from the Georgian Section it was decided to hold the Third Conference in Tbilisi, and it was held there on October 4-9, 1957. Many members of the Georgian section of the Society particularly its President, L. P. Kalandadze, and Deputy President, I. D. Batiashvili, took an active part in the organization of this conference. Two volumes of "Abstracts of Proceedings" were published for the conference— one in Leningrad, and the other in Tbilisi. The Third Conference prolonged the term of office of the Society Council and its Presidium and authorized it to fix the date for the next congress of the Society to coincide with its centenary jubilee .

The resolutions of these congresses and conferences are important documents laying down the program and indicating the present role and aims of the Society and of Soviet entomology in general.

Within recent years the Society has succeeded in bringing out a regular edition of its main publication, "Éntomologicheskoe Obozrenie" , and in 1956 it began to issue it as a subcription periodical with a total volume of 240 pages per annum. For many years Honorary Member A. A. Shtakel'berg has done a great amount of work on the publication of this journal. The most immediate aims include an increase in the size of this journal and a more systematic publication of reviews of current entomological literature.

In 1951, the publication of the Society's "Trudy" begun in 1861, was resumed with the 43rd volume ; unfortunately, its publication is still an irregular feature, and only four volumes have been issued so far. In "Trudy Vsesoyuznogo Éntomologicheskogo Obshchestva" large works which lie outside the scope of the "Éntomologi - cheskoe Obozrenie" are printed.

These are some of the landmarks in the history of the Society and the names of its leading figures. However, the strength and vitality of any scientific association depends on all its members. Our Society can be proud of the fact that its membership has included and includes outstanding scientists and public figures; though many of them were ordinary members, they raised its standing and lent it authority. In view of this we must mention several of its well-known members.

We have already referred to Honorary Member Academician A. O. Kovalevskii, the celebrated evolutionary zoologist. Other prominent zoologists were Prof. A. P. Bogdanov, leader of the Moscow school of zoologists at the end of the nineteenth century, and his disciples,

Academicians N. V. Nanosov, N. M. Kulagin, and V. M. Shimkevich ; Prof. N. A. Kholokovskii, leader of the St. Petersburg school of applied zoologists and entomologists, Academician P. P. Sushkin, and Corresponding Member of the Academy of Sciences, USSR, V. A. Dogel'. Its membership also included the renowned botanists Academician A. F. Famintsyn, Prof. A. N. Beketov, Prof. A. N. Krasnov, Prof. V. A. Transhel' and others; the chemist, Prof. B. N. Menshutkin; I. N. Shatilov, a prominent figure in agriculture; the celebrated travelers P. K. Kozlov; the well-known travelers A. D. Fedchenko, the explorer of Central Asia, and N. A. Zarudnyi, the explorer of Central Asia and Iran, and Academician F. A. Zaitsev, the eminent authority on the fauna of the Caucasus.

Many Society members, representing all branches of entomology and authorities on a large number of questions, stand in the front rank of Soviet entomologists of today. It is worth noting that many of our great entomological scholars are active public figures in different regions of our vast motherland. Some of them have been elected Honorary Members of the Society. Their names include: Prof. E. G. Bekker (Moscow); Active Member of the Academy of Medical Sciences V. N. Beklemishev (Moscow); Prof. I. V. Vasil'ev (Leningrad); Corresponding Member of the Academy of Sciences, Ukr. SSR, Prof. E. V. Zverezomb-Zubovskii (Kiev); Active Member of the Academy of Agricultural Sciences, Georgian SSR, Prof. L. P. Kalandadze (Tbilisi); Prof. A. N. Kirichenko (Leningrad); Prof. A. I. Kurentsov (Vladivostok); Prof. C. G. Lepneva (Leningrad); Prof. S. I. Medvedev (Kharkov); Academician E. N. Pavlovskii (Leningrad); Prof. V. N. Stark (Leningrad); Honored Scientific Worker Prof. D. M. Fedotov (Moscow); and Prof. A. A. Shtakel'berg (Leningrad).

In summing up to foregoing account, we must out that the Society, over the course of a century, has provided a very valuable platform for discussing the infinite variety of entomological questions, and a unique training ground for the country's entomologists.

This function must not underestimated, and its significance is brought out even more clearly by the fact that only 35-40 years ago there were no courses for entomologists in any of the higher educational institutes, far less preparatory courses for specialists in its applied branches. On the whole, by the time of the Great October Revolution, a scientific and ideological potential had been built up and this potential was realized and increased in Soviet times, thus leading to the establishment of specialist education, a system of research institutions for different branches of entomology, a ramified plant protection service and a medical and veterinary entomology service.

Work of Society in Field of Systematic Entomology and Fauna Research

From its very inception, a most important feature of the Society's work has been research on the taxonomy of insects and the study of the fauna of Russia and neighboring countries. A most important concern in this connection was the creation of its own systematic collections, which would serve as reference material for the accurate identification of species; without this there could be no great progress in research on the fauna of the country and on the biology of various species, including pests. The Society instituted a paid post of scientific caretaker of the collections – the Curator, elected from the membership of the Society and a member of its Council.

The question of what these stock collections should consist of was the subject of frequent and lively discussion and was not without value. The setting up and maintenance of a collection of the world fauna was considered too ambitious a project, and at a discussion in December 1865, it was decided that the Society should have a collection of the fauna of Russia and neighboring countries, including the whole of Europe .

A very substantial part of the stock collection was the huge collection of insects from St. Petersburg Province. This had been built up over many years, and from the very first years of the Society's life the study of the local fauna had been encouraged by a Commission for the study of the natural history of the province. In 1907, a Permanent Commission for the study of the insect fauna of the province was set up in order to extend an intensify these researches; V. V. Barovskii , V. V. Mazarakii , G. G. Yakobson, and others took an active part in this commission. By this action the Society gave a gave a definite lead to the activity of its many members, including amateurs.

By this work, which is still going on at present, the study of the insect fauna of the Northwest of our country has reached a very high level. Yet here one can still make interesting faunistic finds and discoveries without going on expeditions to remote parts of the Soviet Union. We can conduct the search for new material in our immediate neighorhood; this is a happy feature of entomology, and one which attracts the experienced research worker, and fires the enthusiasm of the young entomologist. As an illustration we can take the study of the dipteran fauna of Leningrad region by our Honorary Member A. A. Shtakel'berg, a study which he has pursued for more than 50 years and which has increased our level of knowledge of this group of insects in the region from 500 to 2979 species.

The stock collection of the Society included several very valuable collections, which contained types of new species determined by E. Eversmann, V. I. Mochul'skii, F. F. Morawitz, I. E. Faust, and others. We should make special mention of the huge collection of Prof. Eversmann – the greatest student of our country's fauna in the 19th century – from Kazan University; it comprised more than 3 thousand species.

Since it had its own stock collection, the Society was able to deal competently with the numerous requests from different departments and zemstvos regarding the identification of pest specimens sent by them. In addition, the collections enabled the fulfilment of a basic aim –

advancement and intensification of research on taxonomy and on the fauna of the country and neighboring parts of Eurasia.

The Society and its members played a particularly valuable part in the scientific treatment of the vast body of material collected by various travellers, including P. P. Semenov-Tyan-Shanskii, the outstanding explorer of inner Asia, N. M. Przheval'skii, G. N. Potanin, A. P. Fedchenko, P. K. Kozlov, G. E. Grum-Grzhimailo , and others. For instance, it was recorded in the reports for 1887 and 1888 that the identification and classification of the entomological material of the expedition of Przheval'skii and Potanin occupied almost the entire personnel of the Society; reference was made to the great role of the then President of the Russian Geographical Society and later also President of our Society, P. P. Semenov-Tyan-Shanskii, for taking charge of this material and distributing it among specialists. Regret was expressed over the fact that the collection materials of former expeditions had not been acquired by the Society and still remained unclassified. This reproach must be considered as justified, and it was obviously directed at the Zoological Museum of the Academy of Sciences, where very valuable entomological material acquired from many travellers was kept at that time, and being very inaccessible for outside specialists, had lain unexamined for a long time, which led in a number of cases to Russian entomologists losing priority.

One of the earliest concerns of the Society was its desire for the country to have specialists on all the groups of insects and terrestrial arthropods. In the report of 1881 it was noted that in Russia there were no specialists on Orthoptera, Anoplura, Cicadoidea, Nematocera, and certain other groups of Diptera, Symphyta, Formicidae, Chalcidoidea, and others. Subsequently, these gaps were gradually filled, but only now can we say that our country has specialists on the majority of insect groups. Yet even now this concern still remains to some extent; moreover, in the century of great advances in physics and chemistry, it is very important that the resources directed into research in biology, including entomology, should not be reduced, and this constitutes one of the principal present aims of the Society and its members.

In the prerevolutionary period, the question of publishing keys to the insects of our native fauna had been raised. The provision of such keys became more and more necessary, and at first their absence was made up by the translation of foreign texts into the Russian language; however, these texts often omitted species found in our fauna and included species that we lacked.

In 1915, a Commission for the publication of keys was set up, and this body analyzed the general situation and set out to attract to this work all competent entomologists, including nonmembers of the Society. The members of this Commission were A. M. D'yakonov, A. N. Kirichenko, V. V. Redikortsev, M. N. Rimskii-Korsakov, G. G. Yakobson, and others. It was not until 1928 that this undertaking bore fruit with the publication of the well-known "Key to Insects" under the editorship of I. N. Filip'ev, and a small series of keys published with the assistance of N. N. Bogdanov-Kat'kov.

Subsequently, the work on the preparation and publication of keys was transferred to the zoological Institute of the Academy of Sciences, USSR. Beginning in 1935, this body has undertaken the publication of the series "Fauna of the USSR", in which many Society members have participated. A great deal had already been accomplished in this direction; we need only mention that during the past years there have appeared 47 numbers of "Fauna of the USSR" and 36 numbers of "Keys to the Fauna of the USSR" devoted to insects and Acarina. Despite this, the amount of work which lies ahead is still exceptionally large, and will require many decades and the application of many entomological taxonomists. There is a particularly pressing need for a modern key to the insects and Acarina of the European USSR, for several other regional keys, and also for monographs on many families, subfamilies, tribes, and other systematic groupings of these arthropods.

Scientific work in the field of systematic entomology has always bulked large in the publications of the Society. This was a particularly characteristic feature of the 19th century and the early decades of the 20th century. Sometimes, entire volumes were filled with such papers; for instance, in Volume 32 of "Trudy Russkogo Entomologicheskogo Obshchestva" for 1888, 35 out of the 36 papers printed related to systematics.

At the same time, papers on biology and applied entomology usually predominated at the Society's meetings. This circumstance was noted several times in the reports, and can be attributed to the fact that the opportunities for the publication of taxonomic works were always more limited than for researches on biology and on insect pests, as such works could be printed in the various publications of an agricultural, silvicultural, or medical nature. We cannot fail to note a similar situation at the present time; hence we must provide more opportunity for the publication of papers of a systematic-faunistic nature in the publications of our Society.

During the whole 100-year period, 8244 species of arthropods, including 7749 species of insects, have been described in the Society's publications. The course of this process in time can be seen from Table 1.

This table does not include subspecies, many of which were formerly designated as variations; if these were included, the number of new species discovered and described in the Society's publications would be approximately 9,500-10,000 . There is no doubt that some of the described forms will have synonyms. However, the figures given are instructive. They illustrate the great work performed by the Society and its members on the research of our country's fauna and the world fauna as a whole. They indicate the considerable work of a systematic-faunistic nature which is still continuing at the

TABLE 1

Systematic groups	Number of new species described		
	in 25 years (to 1884)	in 50 years (to 1909)	in 100 years (to 1959)
I. Insecta	2125	5658	7749
including			
1) Lepidoptera	812	1013	1104
2) Coleoptera	1099	2609	3165
3) Hymenoptera		1395	1850
4) Diptera	72	176	470
5) Trichoptera	–	–	26
6) Hemiptera s. lato	133	370	662
7) Orthopteroidea	2	41	279
II. Myriapoda	33	39	43
III. Arachnoidea	281	285	350
IV. Crustacea	102	102	102
Arthropoda	2541	6084	8244

present time and is leading to the discovery of many hundreds of new species; this is particularly marked in the case of the Diptera and Orthoptera, where the results of the second 50-year period far surpass the results of the first. There has also been considerable progress in the case of the Hemiptera (s. lat.) where a very great amount of research has been done on the Hemiptera-Heteroptera (A. N. Kirichenko) and the Coccoidea (N. S. Borkhsenius). A considerable amount has been done in some other orders too, viz. Coleoptera (L. V. Arnol'di, F. A. Zaitsev, S. I. Medvedev, N. N. Plavil'-shchikov, A. A. Rikhter, M. E. Ter-Minasyan, etc.), Hymenoptera (V. V. Gussakovskii, N. F. Meier, M. N. Nikol'skaya , N. A. Telenga) and other groups.

An average of 82 species of arthropods have been described every year, and in the first 50 years this figure was nearer 121 species; in view of this, it would seem that the present rate of discovery of species new to science is only about two-thirds of that of the first 50 years. However, this is an illusion. The figures given are totals or averages and hence do not reveal the significant rise noted in recent years; the actual figures for the numbers of new species described in the Society's publications over the last three five-year periods are :

1945-1949. . . . . 173 new species
1950-1954. . . . . 248 new species
1955-1959. . . . . 543 new species

If we take the figures for the last four years (486 species), the average number of new species described annually is 121, i.e. , the average level for the first 50 years .

This is ample evidence of what an inexhaustible source of systematic-faunistic studies the insects represent, and what a great deal of research still lies ahead.

With the study of the fauna, the Society's stock collections increased; some of them were formerly the private property of individual members and in many cases were presented to the Society or acquired by it after the death of their owners. By the beginning of the 20th century this led to great difficulty in housing and looking after the collections, and in 1910 it was decided to restrict the stock collection to the fauna of St. Petersburg Province. In view of this, the bulk of these collections, including the extremely valuable collection of Prof. Eversmann, was handed over in 1908 to the Zoological Museum of the Academy of Sciences. Later, the Zoological Museum received the other collections, including the fauna of the Leningrad Region; the Society gave up the aim of having its own collection and in 1931 the post of Curator was dispensed with.

The general result was that the Society made its contribution to providing the country with the vast stock collections which have been built up over several generations in another institution—the Zoological Museum, now the Zoological Institute, of the Academy of Sciences, USSR.

These systematic collections provide a unique source of reference for species identification, and in general, constitute a very valuable national heritage; such is the nature of systematics that without these collections, accurate identification of very many species would be impossible, and consequently the rapid progress in the field of systematic-faunistic research of our country—the keystone of further theoretical and applied research—would also be impossible.

Work of Society in Area of Applied Entomology

The link of entomology qith practice has been one of the most important aspects of the Society's work from its

very inception. At that time the country had no organizations for plant protection, or even for the control of insects of medical or veterinary importance. Neither in our own nor in other countries had there been laid down the scientific groundwork of agricultural and forest entomology, or of medical and veterinary entomology, and these branches of entomology had not yet developed into independent scientific disciplines.

At the same time, life was making its own demands; these were particularly urgent in the case of agriculture and forestry, which were suffering huge losses from pests.

As early as the 1860 meetings, Academician Baer put forward a number of ideas relating to problems of research on insect pests, and these were published shortly after in the form of paper "Observations on injurious insects and methods of combatting them" (1861). The fundamental feature of this paper was the clearly formulated view that effective control measures against pests could only be developed on the basis of a study of their biology and "a knowledge of the laws of science" i.e. with the due regard for the theoretical information garnered by science, and by the application of scientific theories.

In October 1860, at Academician Baer's suggestion, the Society set up a Commision on Injurious Insects with two basic aims: the compilation of reference works, including systematic catalogs of insect pests, and the elaboration of control measures against them; it was indicated that these measures should aim not only at extermination, but also at prevention. Hence, even at that time there was a clear understanding of the importance of prevention in pest control. The idea of compiling reference works on the country's insect pests is also worth noting. It was not until 20 years later that this idea materialized with F. P. Keppen's classic work "Injurious Insects" (1881-1883). It was not until our own time, in 1932, that the idea of compiling systematic catalogs of pests was realized by the All-Union Institute of Plant Protection, who published a "List of Insect Pests of the USSR and Neighboring Countries" (edited by A. A. Shtakel'berg), and in subsequent years the Zoological Institute of the Academy of Sciences, USSR published two works "Injurious Animals of Central Asia" (1949) and "Forest Pests" (1955). Although these publications cannot be credited directly to the Society, they were produced by a large team of authors — Society members — and the original idea dates back to the infancy of the Society. We should note that publications of this type are almost completely new to modern world literature.

Early in 1861, the question of locust control measures was placed before the Society. F. P. Keppen, who was working at that time under the Department of Agriculture in south Russia, was commissioned to conduct locust research in that region. In addition, with the subsidies obtained in 1862-1863, Founder Member A. A. Kushakevich was twice sent to south Russia for the purpose of conducting locust research.

As a result it was established that the damage was caused by two species of locust—the migratory locust (Locusta migratoria L.) and the Italian locust (Calliptamus italicus L.); the works published by these two investigators were a great step forward, particularly F. P. Keppen's authoritative work "The locust and other injurious Orthoptera", printed in the "Trudy" of the Society in German (1866) and Russian (1870).

However, the problem of locust control at that time was extremely difficult and complex and it was clearly realized in the Society that due success in the study of these pests could only be attained by the organization of simultaneous investigations at many points and over a vast territory from the Danube to the Kuban and Kuma. Such a task was out of the question then, since it required great resources and many specialist research workers; but the statement of the question was correct. Only a series of investigations carried out over a period of several generations of entomologists of pre- and post-Revolution times have provided the necessary knowledge, and now, a century later, we realize how much had to be done in order to produce significant practical results.

It is worth recalling A. A. Kushakevich's suggestion, in 1863, that an international commission should be formed to undertake general measures against the migratory locust in the Danube delta (Trudy III, 20, 1865). This proposal was not put into effect at that time, but in the history of entomology it must be regarded as one of the earliest glimmerings of the idea of international cooperation in the work of plant protection in general, and in locust control in particular.

The Commission on Injurious Insects was confronted also with the question of the winter cutworm (Agrotis segetum Schiff.) and the elaboration of control measures against it; for this purpose, Founder-Member O. V. Bremer was sent to Kostroma Province in 1862. A member of the above Commission, Yu. I. Simasko, was also commissioned to undertake research on forest insect pests in the Northwest of the country.

However, owing to the very low scientific level of entomology at that time, the founders and members of the Commission on Injurious Insects could not forsee the extraordinary complexity of plant protection problems. We need only mention that the above-named work of F. A. Keppen on the locust was considered by his contemporaries as almost the limit of our knowledge, and yet it was of very little practical value. The reason lay in the fact that at that time the scientific principles of agricultural and forest entomology were just being born; the knowledge of the laws of multiplication of pests was very slight; there were still no teams of specialists; the technical development, industry, and agriculture of many countries were at a very low level. In general, human culture at that period had not yet attained the required level, and not a single problem of plant protection could be resolved at that time.

It soon became clear how inadequate the Commission was for the problems confronting it, and it was reorganized,

only to be completely disbanded in 1868. However, plant protection problems remained one of the principal concerns in all the subsequent work of the Society.

An interesting idea was put forward in 1873 by Founder-Member K. G. Gernet; he advocated that entomological stations ought to be organized in Russia and these should be set up in "centers of cultivation of important crops, such as flax, tobacco, sugar-beet, fruits, market-garden crops, etc". (Trudy, VII, 1873). However, it was not until 30-40 years later that such stations began to appear in our country, among them being the first entomological station, set up in Kiev in 1904 by the prominent Society member V. P. Pospelov, later Professor and Academician of the Ukrainian Academy of Sciences.

In 1873 and 1875, K. G. Gernet drew attention to the Colorado or potato beetle (Leptinotarse decemlineata Say), and to the danger of its importation into Europe; in 1875, Russia passed a law relating to quarantine measures against this pest.

In the discussion that prevailed over the wide-scale occurrence of the cereal beetle Anisoplia austriaca Hrbst. in the south of the country, and measures suggested for its control, advanced opinions for that time (1878) were expressed on the inadequacy of mechanical measures of control and the necessity for employing agrotechnical measures to prevent the appearance of the pest; introduction of a crop rotation system, improved methods of soil tillage, and the eradication of waste ground and overgrazed land. Waste ground and overgrazed land, in the picturesque expression of Society member N. A. Poletaev, constituted "a haunt, a breeding ground for a myriad of insect pests, a sort of ulcer in agriculture" (Trudy XII, 1879; XXVIII).

In our modern socialist agriculture this "ulcer" has lost its former significance, and thus a number of pests have either departed from the scene (for instance, the spring cutworm —Apamea paludis Tutt.), or there has been a reduction in the damage caused or the area affected (for instance, locusts); losses due to them have been reduced or completely eliminated, but nowadays we do not notice the great effect this had on the national economy, though it would certainly have surpassed the result of several years of operation of thousands of airplanes destroying pests by chemical methods.

At the end of the seventies and in the early eighties the work of the Society entered a new plase. A series of excursions and pest field studies was organized by two of its very active members — V. I. Filip'ev and I. A. Porchinskii. The number of persons dealing with problems of plant protection rapidly expanded; these included several Society members—the celebrated A. O. Kovalevskii, K. L. Bramson, I. M. Krasil'shchik, S. A. Morkrzhetskii, A. A. Silant'ev, N. N. Sokolov, S. I. Torskii, I. Ya. Shevyrev, and others. Entomology was enriched with new scientific information on a number of very important pests — the vine phylloxera (Phylloxera vastatrix Planch.), the cereal beetle , winter and spring cutworms, the Hessian fly (Mayetiola destructor Say), the grain flea beetle (Chaetocnema aridula Gyll. and Ch. hortensis Geoffr.) the tobacco thrips (Thrips tabaci Lind), etc.

This increased interest in plant protection problems was indicative of the efforts of progressive forces in the country to find ways of reducing agricultural losses due to pests, which at that time caused terrible destruction owing to the backward methods of agriculture and the lack of entomological knowledge. We must mention that these efforts were supported by the very eminent biologists A. O. Kovalevskii and I. I. Mechnikov, although neither were entomologists, and the latter was not even a member of the Society. They both contributed a great deal to the development of the theory and practice of plant protection in our country; they were responsible for the idea of the microbiological method of pest control, they took an active part in the entomological congresses organized by the zemstvos in the south of the country, and A. O. Kovalevskii, in addition, energetically sought for ways of combating the vine phylloxera, which had been imported into our country; he also, as early as 1889, raised the question of providing a course of entomology in Novorossiisk (now Odessa) University.

This stimulation of entological work prepared the soil for the organization of a special state institution for plant protection, the Bureau of Entomology, set up in 1894 under the Ministry of Agriculture and State Property; this Bureau was directed by I. A. Porchinskii — one of the greatest figures in Russian entomology. We should note that prior to the founding of this Bureau, the authorities took practically no part in the organization of scientific research on plant protection and in conducting measures against pests. This brings out the importance of our Society and its members as a public force which prepared the ground for the creation of a plant protection service in our country.

From its very inception, the Bureau of Entomology received the universal support of the Society and occupied the same premises as it (in the building of the former Ministry of Agriculture and State property, now Ulitsa Gertsena 42), and the staff of the Bureau had full access to the library and the collections. As a result of this the difficulty of the organizational period was reduced to a minimum, and the Bureau was able to get down to active work on plant protection straight away; it naturally became the center responsible for all the work in this field.

In the following period, the Society's work in the sphere of agricultural and forest entomology developed along two main lines : discussion of various papers in these sciences at the scientific meetings and the participation of its members as staff of various institutions concerned with pest research , and , in the elaboration of control measures, the advocacy of new scientific or organizational principles and ideas, their realization in science and practice, and the setting up of entomological schools.

The discussion of all these questions would take us

far away from our main theme, and hence we will confine ourselves only to a few of the most important questions, particularly since we have already discussed some of them.

The end of the 19th century, the beginning of the 20th , and the prerevolutionary period were characterized by the emergence of very eminent figures in agricultural and forest entomology from the ranks of the Society : These were Honorary Member Prof. N. A. Kholodkovskii, founder of the St. Petersburg school of applied entomology; Prof. N. M. Kulagin, later Academician, leader of a similar school in Moscow; organizers of entomological bureaus, stations, and sections in the country — V. P. Pospelov, S. A. Mokrzhetskii, V. I. Plotnikov, N. V. Kudryumov, V. G. Averin, N. L. Sakharov, etc.; other prominent figures were I. Ya. Shevyrev, well-known for his research on forest pests, including pests of steppe woodlands, and A. A. Silant'ev, an advocate of special training in plant protection.

We must make special mention of N. V. Kudryumov, who died prematurely in 1917. He was one of the founders of the agronomic trend in agricultural entomology; in a series of brilliant works he showed that research in this field was concerned equally with insect pests, cultivated plant, the environment of both, and the interrrelations between them. He formulated new theoretical principles for agricultural entomology and, in effect, raised it to the status of an independent scientific discipline. We must also mention another service rendered by N. V. Kudryumov; he initiated the research in our country of that vast group of beneficial insects, the Chalcidoidea, which play a very important role in the biological control of pests.

In the early years of the post-October period, the civil war and economic dislocation led to a great decline in agriculture; there appeared huge areas of barren, weed-covered lands, which provided particularly favorable conditions for outbreaks of locusts and other pests. Like a terrible legacy, these pests swarmed over vast areas of the country, and the primary need was for specialist personnel capable of understanding and determining the specific nature of the pests and of organizing control measures, in order to reduce the damage caused and to save the harvest. In 1920, the Society set up a Section of Applied Entomology and this Section, which existed till 1930, was an additional training ground for the first generations of Soviet entomologists; the audience at its meetings often consisted mainly of students taking the advanced courses in applied zoology and phytopathology, started by N. N. Bogdanov-Kat'kov in 1922 and based on the principles put forward by A. A. Silant'ev. Prominent members of the Society became the lecturers for these courses.

In the early twenties, the airplane was used in pest control for the first time in the history of plant protection on the suggestion of V. F. Boldyrev, a laureate of the R P. Semenov-Tyan-Shanskii Prize of 1917 and later an Honorary Member of the Society; from that time the aerial method of pest control has become widely adopted in our country, and this is largely due to the efforts of many Society members.

In 1930, prominent members of the Society — V. P. Pospelov and I. N. Filip'ev —took part in the organization of the All-Union Institute of Plant Protection as the leading scientific institution of the country. Well-known Society members—D. A. Ogloblin, A. S. Skorikov, V. N. Stark, A. A. Shtakel'berg, and others — were enlisted for the leading posts in this Institute.

At the Society meetings, the subjects of discussion included some of the most important pests, such as the vine phylloxera, the meadow moth (Loxostege sticticalis L.), wireworms, etc. questions of plant quarantine, and the biological control of pests. In 1935, problems of agricultural entomology formed the main topic of a meeting dedicated to the 75th anniversary of the Society, where Prof. V. N. Shchegolev read a paper on the theme "Agriculture in the USSR and entomology".

Since 1937-1938 many Society members have given their attention to a very important cereal pest — the shield bug Eurygaster integriceps Put, which has multiplied in a great wave almost without a break since then to the present day. Centers for research on this pest were set up, particularly in the All-Union Institute of Plant Protection (works of D. M. Palkin, P. A. Sazonov, V. A. Shchepetil'nikova , etc.) and in the A. N. Severtsov Institute of Animal Morphology in Moscow (works of Honorary Member of the Society D. M. Fedotov and his colleagues— K. V. Arnol'di, A. A. Peredel'skii, etc.). The question of the shield bug pest became one of the most important at the Society meetings, and since 1950 — at its congresses and conferences, and in several of the Sections. The efforts of many years have led to the discovery of the pattern of its biology and to an understanding of the causes of outbreaks, thus providing the necessary theoretical foundation for the elaboration of effective control measures against it.

Since the Thirties an increasingly important element in the field of forest entomology has been concern over the problems of pests in shelterbelts and three plantings in the steppe zone. These investigations reached a peak in the last decade as a result of the well-known decrees on shelterbelt afforestation. This research involved many entomologists (M. M. Aleinikova, N. S. Andrianova, V. M. Berezina, V. A. Vainshtein, Z. S. Golovyanko, N. S. Greze, V. I. Gusev, B. V. Dobrovol'skii, D. P. Dovnar-Zapol'skii, L. Z. Zakharov, D. V. Likventov, V. Ya. Parfent'ev, P. A. Polozhentsev, D. V. Pomerantsev, P. M. Rafes, V. N. Stark, P. G. Troshanin, A. I. Cherepanov, etc.); we should take special note of the outstanding role of our Honorary Member, V. N. Stark, in organizing these researches. Shelterbelt afforestation also stimulated the study of several questions of the faunistics, biology, ecology, distribution, and behavior of insects, and advanced the development of scientific theory and the formation

of new ideas in the field of entomology (the works of K. V. Arnol'di, M. S. Gilyarov, S. I. Medvedev, A. N. Mel'nichenko, V. N. Stark, and several members of the Zoological Institute staff, led by L. V. Arnol'di, D. M. Shteinberg, etc.).

Since 1950, with the organization of Society Sections in various parts of the country, questions of plant protection have become a very important subject at their scientific meetings and conferenferences. These questions occupy a considerable part of the program of congresses and conferences of the Society.

Progress in the chemical control of pests in the last decade and the rapid effect achieved by the employment of chemical methods have sometimes led to an undue emphasis on it and an underestimation of other methods of control, particularly agrotechnical method and general farm management. For the Prof. N. A. Kholodovskii Memorial Lecture in 1953, the Society produced a program paper by V. N. Shchegolev entitled "Directed alteration of the conditions of existence as a means of protecting crops from damage", which was published in 1954. This paper revealed the great variety of ways of controlling pests by means of agrotechnical measures and the proper organization of crop growing.

At the Second All-Union Conference of the Society in 1954, a number of biological questions relating to the protection of plants from pests were discussed. In addition, G. Ya. Bei-Bienko gave an address: "Some problems of entomology in connection with the task of increasing agricultural production", in which the most important questions of theory and practice were raised; in particular, attention was drawn to the entomological problems arising out of the cultivation of virgin and long-fallow lands, to the application of the theory of Academician E. N. Pavlovskii on the natural focalization of human and animal diseases in agricultural entomology, and so on. The published resolution of this conference outlined a program of the most important tasks of Soviet entomology in all its branches, including plant protection.

At the Third All-Union Conference in Tbilisi in 1957, papers on agricultural and forest entomology and related branches took up about 43 % of its program; in the two publications "Abstracts of Proceedings", published for this conference, questions of plant protection were dealt with in 80 papers. More than 80 papers on these questions were included on the agenda of the Fourth All-Union Congress of the Society, not counting those which were just printed in the published "Abstracts of Proceedings" and were not submitted for discussion.

Thus, during the last decade, the Society has become an All-Union platform for the discussion of various scientific problems of agricultural and forest entomology, as well as of all other general and applied entomological disciplines.

As regards medical and veterinary entomology the work of the Society in these branches of knowledge was initiated by I. A. Porchinskii in 1870, when he read a paper on the horse bot fly (Gastrophilus intestinalis Deg.) and the rain fly (Chrysozoma pluvialis L.). After this, investigations on dipteran parasites of man and domestic animals constituted one of the most important lines of scientific work of this versatile entomological scholar; here we should recall his series of works and papers on the Wohlfahrt fly (Wohlfahrtia magnifica Schin.) and on myiasis in man and animals, on research on bot and warble flies, on the biology of tabanids and control measures against them, on the malarial mosquito (Anopheles maculipennis Mg.), etc. The results of these investigations were printed in the Society's "Trudy" between 1871 and 1898, and when the Bureau of Applied Entomology was set up, in its "Trudy" (1899-1916). On the whole, I. A. Porchinskii's studies covered questions of the taxonomy, biology and control measures against dipteran enemies of the health of man and domestic animals.

The work of another outstanding member — N. A. Kholodkovskii — in this field began a little later and was mainly concerned with questions of the morphology of insects of medical importance : cockroaches, lice, the bed bug, and fleas. In 1879 he read one of his first scientific papers to the Society — on the salivary glands of the German cockroach (Blatella germanica L.) and the oriental cockroach (Blatta orientalis L.), and in 1881 he had one of his first works printed in the Society's publications. In a series of investigations on the morphology of lice he demonstrated that they must be separated into an independent order, to which the name Pseudorhynchota was given. In the same series of works he expressed his view on the fleas, and showed that owing to the special features of their morphology they also must be regarded as a separate order (1914).

A substantial contribution to the resolution of the systematics of fleas was made by Yu. N. Vagner, who began his work in the Society in the late eighties of last century and published a large number of works.

In 1908, E. N. Pavlovskii's work on the anatomy of the genitalia of lice was published in the "Trudy" of the Society. This began the period of his close association with the Society, an association which has lasted till the present day. At the meetings he gave a series of papers on the anatomy of scorpions and insects, venomous forms being one of his special interests, on insects and mites as disease vectors, on insects as intermediate hosts of parasitic worms, and so on. A very notable general conclusion was his theory of the natural focalization of vector-borne diseases, a theory which stimulated the development of research on parasitology and medical-veterinary entomology in the USSR and abroad, and assisted in the formulation of principles of prophylaxis and in the control of several serious diseases; among the latter we should make special mention of tick-borne encephalitis, in the study of which E. N. Pavlovskii himself directly participated and helped in organization; for this work he was awarded a Stalin Prize (First Class)

in 1941; a second Stalin Prize (First Class) was awarded to E. N. Pavlovskii in 1950 for his fundamental two-volume manual on human parasitology, the second volume of which was devoted to questions of medical entomology.

Of the other vector-borne diseases we should mention tularemia and Siberian plague, which are transmitted, according to the studies of N. G. Olsuf'ev and other Society members, by tabanids and mosquitoes, and in the case of tularemia, by pasture ticks as well. As early as 1934,N. G. Olsuf'ev addressed the Society on the role of tabanids in the transmission of tularemia.

Very recently the role of mosquitoes in the transmission of neurogenic infections was discovered; as regards research on the transmission of this type of disease we should note the works of A. V. Gutsevich, who read a long paper on this theme at the Third All-Union Conference of the Society in Tbilisi in 1957 .

By the end of the 19th century it was established that malaria was transmitted by mosquitoes of the genus Anopheles Mg., which since then have been called malarial mosquitoes. Research on malarial mosquitoes and malaria control began to attract the interest of several Society members. We have already mentioned I. A. Porchinskii in this connection, but G. A. Kozhevnikov (1901, 1903) and A. S. Skorikov (1906) were the first to contribute to this question at the Society's meetings and in its publications. However, it was not until many years later that this problem became the subject of all-round investigation and the concern of many research workers, among whom we should mention especially the names of two Honorary Members of the Society — V. N. Beklemishev and A. A. Shtakel'berg .

V. N. Beklemishev was responsible for founding an extensive school of research workers on the biology and ecology of the malarial mosquito, and this school has been working intensively for more than 30 years already. He and his co-workers — T. S. Detinova, N. K. Shipitsina, and others — have on several occasions read papers on the results of their researches at meetings of the Moscow Section of the Society.

In the Twenties and ThirtiesA. A. Shtakel'berg dealt with questions of the taxonomy of malarial and other mosquitoes, and this provided a very important theoretical basis for further comparative biological research of different species; in 1924, E N. Pavlovskii and A. A. Shtakel'berg set up an important center for research on this problem — the Permanent Commission for the study of Malarial Mosquitoes, attached to the Zoological Institute. The works of A. S. Monchadskii on the larvae of these insects contain a lot of new information on the morphology and taxonomy of mosquitoes in general, including malarial mosquitoes; he also studied questions of the attacking behavior of mosquitoes and other bloodsuckers, and employed for this purpose a new, original method (Monchadskii's bell , later improved by Chagin, which is used for counting the numbers of attacking mosquitoes).

All these entomological researches created a sound theoretical basis for the elaboration of a malaria control system and for the prevention of this disease in our country; as a result, malaria as a widespread disease was eradicated in the USSR by the early Fifties. This service of Soviet entomology was acknowledge by the award of a Stalin Prize (First Class) to V. N. Beklemishev, and to N. K. Shipitsina and her colleagues.

One of the most important present-day problems in medical and veterinary entomology is presented by the complex of bloodsucking flies to which the expressive Russian term "gnus" has been given. The problem of bloodsucking fly control is now attracting wide attention in connection with the vast industrial construction and agricultural development in the new regions of Siberia and the Far East. In this research several Society members are taking part — V. N. Beklemishev, A. V. Gutsevich, A. S. Monchadskii, I. A. Rubtsov, M. F. Shelenova, and many others. Yet this problem is so complex and many-sided that it can be resolved only by the organization of large teams of scientists to conduct investigations on a broad front. Our Society can play an important part in deciding future lines of research and in the coordination of the latter.

The study of another group of bloodsucking diptera — the sandflies, which are of great importance in the south of our country both as bloodsuckers and as vectors of diseases of man and domestic animals, also involves many research workers, among which we might name the following Society members— A. V. Dolmatova, N. I. Latyshev, P. P. Perfil'ev, P. A. Petrishcheva, and others.

A special trend in medical entomology is the study of the complex of synanthropic flies as disease vectors and annoying associates of man. Researches of this type were begun in Moscow in the thirties by E. S. Smirnov and are now being widely conducted by many Society members in various parts of the USSR. An important aspect of this problem is the study of the taxonomy of this complex (A. S. Shtakel'berg's works) and their larval forms (L. S. Zimin's works). Questions of biology and control measures against synanthropic flies are now the subject of intensive research by V. P. Debrenova-Ukhovaya, D. L. Shura-Bura, and others; the latter has used tracer atoms for studying the radius of their flight; these two workers have read papers to the Society on several occasions and have had a series of works printed in its publications.

Of particular significance in the field of veterinary entomology is the research on bot andwarble flies and on pasture ticks. However, we will not deal with the latter here in view of their special nature, and will merely note that a great deal has been accomplished in investigations on the taxonomy, morphology and biology of mites and ticks, the transmission of diseases by them and the elaboration of control measures against them;many of these studies are also of medical importance, as we have already mentioned above.

As regards bot and warble flies, we can see from the preceding account that their study was not begun in the

Society till the seventies of last century. Questions of their systematics are now being successfully dealt with by Society member K. Ya. Grunin, and questions of biology and control measures by a number of members, among which we must mention the names of K. A. Breev, D. V. Savel'ev, and other investigators.

In the last decade, questions of medical and veterinary entomology have become the subject of wide discussion at the All-Union congresses and conferences of the Society, and have occupied a substantial part of their program. Several of the Society sections are also showing interest in these studies.

These are some aspects of the work of the Society and its members in the field of applied entomology during the last 100 years.

Publications, Library and General Meetings

The publication of scientific works has always been a basic activity of the Society. At present, besides the periodical "Éntomologischeskoe Obozrenie" (38 volumes were published between 1901 and 1959 inclusively) and the nonperiodical collections "Trudy Vsesoyuznogo Éntomologicheskogo Obshchestva" (46 volumes published since 1861), the Society publishes :

1) "The Prof. N. A. Kholodkovskii Memorial Lectures" —small collections for the publication of papers read at the annual lectures (six collections produced since 1951);

2) The popular science series — irregular editions on individual questions of entomology and closely related sciences — started to appear in 1950; seven pamphlets have been published altogether : on the spider mite and its control (N. V. Bondarenko, 1950), on natural enemies of citrus crop pests (I. A. Rubtsov, 1954), on insects (É. K. Grinfel'dt, 1954) and humble bees — clover pollinators (G. S. Voveikov, 1954), on pests of park plantings and their control (Z. G. Belosel'skaya, 1955), on the reindeer warble fly and its control (K. A. Breev and D. V. Savel'ev 1958), and on clothes moths —household pests — and their control (A. K. Zagulyaev, 1958);

3) "Abstracts of Proceedings" at congresses and conferences of the Society : In 1957, the Society published two numbers of "Third Conference of the All-Union Entomological Society. Abstracts of Proceedings" (containing 183 articles), and in 1959, two numbers of "Fourth Congress of the All-Union Entomological Society. Abstracts of Proceedings" (containing 253 articles).

Through its publications, the Society has for long enjoyed prestige and high esteem both within the country and abroad. As early as 1888, in connection with its participation in the Siberian-Ural Science and Industry Exhibition, it was awarded a diploma and was considered "worthy of a gold medal for excellent publications on entomology". At the present time the "Entomologicheskoe Obozrenie" is being republished in English in the U.S.A.

The total scientific production during the 100 years and during the two 50-periods, as well as some average figures, is illustrated by the figuresgiven in Table 2.

Thus, during the period the Society has published 3050 signatures, containing 3311 scientific papers and about 4300 various other articles. A comparison of the first and second 50-year periods reveals a substantial difference in the figures : in the second 50-year period 20 % fewer signatures were published, twice as many scientific papers were published, and only half as many other printed articles (reviews, reports, etc.). These figures reflect the stormy nature of the life of our country in the second 50-year period : two world wars, the Great October Socialist Revolution, the Civil War, and the colossal difficulties which we had to endure through this time. This caused not only a marked reduction, and at times a complete cessation of the Society's publishing activity, but also forced it also to abandon even the printing of major works and the systematic publication of literature reviews, proceedings and news items.

The turning point was reached in 1956 when the "Éntomologicheskoe Obozrenie" became a periodical journal again. Within the last four years the Society has published two volumes of "Trudy Vsesoyuznogo Éntomologicheskogo Obshchestva", four numbers of "Abstracts of Proceedings" as well as certain other productions. As a result the printing production for this period reached an annual average of 93 signatures, as compared with 60 in the flourishing period of publishing activity in the prerevolutionary period, viz. 1910-1913 .

Hence, during the last four years the Society's printing production was half as high again as the highest level attained in the prerevolutionary period. However, we cannot be satisfied at present with the figures reached,

TABLE 2

	1859-1909		1910-1959		Total for 1859-1959	Signatures published	
	total	yearly average	total	yearly average		1910-1913	1956-1959
Signatures published.....	1700	34	1350	27	3050	60	93
Scientific papers published....	1259	25.2	2046	41.0	3305	65	196
Reviews, reports, news articles, etc. published.....	over 3000	60.0	1284	25.7	about 4300	136	15

in view of the considerably increased membership; in fact the 60 signatures in 1913 corresponded to 397 Society members, whereas the present 93 signatures corresponds to 1460 members. It is obvious that to satisfy the very much greater needs of the Society and its members the volume of its publishing output must be doubled at least; in the first place the pagination of the "Éntomologischeskoe Obozrenie" must be increased by 50-100 % and one volume of the "Trudy Vsesoyuznogo Éntomologischeskogo Obshchestva" must be produced annually.

From a comparison of the average figures for 1910-1913 and 1956-1959 we can note two further points: the marked increase in the number of scientific papers published annually (197 per year in recent years as compared with 65 in 1910-1913) and the extremely inadequate present amount of Society work in the reviewing of current literature and in the coverage of current events in the entomological life of the country. While the first of these facts reflects the Society's efforts to give its greatly increased membership the opportunity of publishing scientific works by a reduction in their length, the second—the smaller coverage of literature reviews and science news — cannot be considered as normal. It is obvious that one of our tasks must be to counter this slackness , a legacy of past difficulties, and for this it is particularly necessary to amplify considerably the critical reviewing of current entomological literature; the informatory work of the Society will thus be enhanced and this will have a beneficial effect on the quality of the entomological works published in our country.

In its present publishing work,the Society is following a definite system and is selecting articles for publication not merely in the order of their receipt by the editorship but in accordance with their content and scientific value. In addition, the requesting of articles on particular subjects will be adopted where necessary. As an illustration of this we can take Vol. 36 of the "Entomologicheskoe Obozrenie", which contained a series of articles reviewing the progress of Soviet entomology in its various branches in connection with the 40th anniversary of the Great October Socialist Revolution.

The Scientific Library of the Society is a very rich storehouse of literature on entomology and related branches of knowledge. At present its stock comprises approximately 50 thousand library units (periodical publications of the last 25 years are counted as the number of titles received each year, and not as the number of separate issues), among which the greatest part consists of foreign periodicals.

The main source of growth and stocking of the Library is the exchange of publications: International exchange with foreign entomological societies and related organizations is very considerable. However, large gaps, particularly in the runs of foreign periodicals, were created during the war and postwar years. The position did not improve with the centralization of international exchange in the Library of the Academy of Sciences, USSR, in the late forties. This led on the whole instead to the severance of a number of traditional exchange connections of the Society and greatly reduced the acquisition of foreign journals between 1940 and 1955 ; for instance, in 1935-1939 the average number of foreign journals received annually comprised 194 titles and in the period 1947-1955 the average was 66 titles. It was not until the period 1956-1959 that this figure rose to an average of 135. There is still a great deal of effort required in order to fill the gaps in sets of periodicals; fortunately, the Society possesses a considerable stock of most of its old numbers for exchange.

Important additions to our library were a collection of books and offprints numbering about 2500, a bequest from the library of the late Honorary President M. N. Rimskii-Korsakov, and a collection of publications on insect coloration, received in 1959 , a bequest from the library of the late Vice-President, B. N. Shvanvich .

We should note the excellent practice of several members of presenting to the library separates of their works and other publications. It would be a good thing if this practice were to spread to all Society members, particularly in respect od those works which are printed in provincial or departmental publications which are difficult to obtain (for instance, in publications of higher educational institutes, various stations, etc.); in this way such works will be accessible to a large number of entomologists.

The scientific meetings of the Society are a basic form of its work both in the center and in the sections. During the 100 years the central body has held 913 general meetings in all, the total number of papers read being about 2000; the corresponding figures for the first 50 years were 471 and 1080, and for the first 75 years (to 1935) were 729 and 1729. These figures do not include papers read at conferences and congresses of the Society or at the Prof. N. A. Kholodkovskii Memorial Lectures but if these were included the total number of papers read to the Society would reach 2500. However, the actual number would be considerably in excess of this,in view of the activity of the sections.

CONCLUSION

The foregoing account of the Society's work during the past hundred years demonstrates the outstanding part it has played in the development of scientific entomology and the practical entomological service of our country. This certinly constituted its great role in our advancement. In its work as a whole the Society showed an advanced outlook, lending its support to many progressive undertakings and putting into practice democratic principles, even in those times when this did not correspond to the governmental and public standards prevailing in the country.

By answering the numerous inquiries from the provinces,it promoted the spread of scientific knowledge and its application in practice. In many cases these inquiries

were accompanied by requests for identification of insect specimens sent; sometimes such requests coming from school teachers, who sent their pupils' collections for identification. These request were usually dealt with eagerly and promtly, a service in which several Society members took part; we should not forget that this was done without charge.

The Society actively responded to various public scientific events connected with the work of scientific bodies, teaching institutes or individual personages. For instance, in 1903 it took part in the 25th anniversary celebration of the Women's Higher Courses in St. Petersburg. In 1904 it honored a prominent figure in Agriculture, I. A. Stebut, the founder of the Stebut Women's Higher Agricultural Courses, which was one of the forerunners of the present Leningrad Agricultural Institute, in 1911 it actively participated in the 200th anniversary of the birth of M. V. Lomonosov, and so on.

Though almost always short of funds, the Society gave as much material support as possible to certain progressive undertakings. For instance, in 1902 it allotted a small sum to the Minusinsk Museum for the formation of a fund in memory of the recently deceased N. M. Mart'-yanov, a well-known public figure in Siberia, the founder of this museum and a Society member since 1877; this fund was designed for the organization of research in the former Yenisei Province. In 1903 a sum was allotted to the Novorossiisk (now Odessa) University for a stipendium in the name of Honorary Member Academician A. O. Kovalevskii. In several cases the Society's publications have been sent at reduced price to various local museums and societies. In 1909 the Society acceded to the request of 13 St. Petersburg students, who were interested in entomology, to sell them the Society's publications at reduced price, and the students themselves were enrolled as correspondents. The Society gave material assistance to its supporters (or their families) in cases of illness or death, though it had no legal obligations in this respect; in 1914 it also granted on its own initiative a monthly pension for a period of five years to the family of a deceased member.

It was certainly an audacious and generous act of the Society to support the Pole B. I. Dybowski, a political exile in Siberia whose study of the gammarid crustaceans of L. Baikal was published by the Society in 1874 . In 1906 the Society discussed the question of identification of the insects collected by M. V. Novorusskii in the prison courtyard of Schlusselburg fortress during his 20-year imprisonment; the meeting decided to undertake the scientific treatment of this collection, and the results were published in the "Trudy" of the same year.

The Society forms at present a large association of entomologists with branches throughout the country, the present stage of development for which its hundred years' history has prepared it. The greatest service of the Society was undoubtedly its contribution to national science and culture; it laid the foundation of scientific entomology in our country and fostered the development of its applied branches.

As a complex of special subjects, entomology in our time plays an important part in the study of the natural conditions of our country, in the revelation of biological laws, in raising the productivity of agriculture and forestry, and in the care of human health. It is this manifold role of entomology which is responsible for its present complex and ramifying system of research and practical application.

This network of research and practical application has not yet reached the necessary level of development, as not all that has been accomplished in scientific entomology has found its due measure of practical application, with a great deal still to be done to remove several serious shortcomings. On the whole, however, the present role and structure of scientific and practical entomology in the country differs radically from the situation of 25-30 years ago, and even more so from that of the pre-revolutionary period. Nemerous centers or study groups for general and special entomological research have been formed in the systems of the Academy of Sciences, USSR; the V. I. Lenin All-Union Academy of Agricultural Sciences; the Academy of Medical Sciences, USSR; the Academies of Sciences of the Union republics, and in other departments. Besides the Zoological Institute of the Academy of Sciences, USSR; the All-Union Institute of Plant Protection of the Lenin All-Union Academy of Agricultural Sciences; the Institute of Epidemiology and Microbiology of the Academy of Medical Sciences, USSR; and the Institute of Medical Parasitology and Tropical Medicine of the Ministry of Health, USSR, as the leading scientific institutions, there is also a fairly comprehensive ramifying network of research institutes, sections or stations studying a great variety of problems of entomology and related branches of knowledge. An important part is also played by the corresponding departments of universities, agricultural, medical and other higher teaching institutes dealing not only with questions of science, but also with the training of entomologists and the production of textbooks and manuals.

This determines the present aims of the All-Union Entomological Society. They differ substantially from its earlier aims, when the country had no complex, ramified and diversified system of entomological research and practical service, when the Society was the main or even the only specialist entomological organization.

With such a wide front of entomological work, and in our century of extreme specialization and differentiation of knowledge, the basic and most important function of the Society is its role as a unifying general organization and as a national platform for the consideration and discussion of scientific problems of entomology in all its branches and trends. The media for this are its scientific meetings, conferences, congresses and its publishing work.

Important tasks of the Society are the strengthening of the active role and value of its Sections as local interdepartmental entomological centers, the wide

attraction of new Society members from research and industrial organizations and institutes, the popularization of entomology, and a significant expansion of publishing work, primarily by increasing the pagination of the journal "Éntomologicheskoe Obozrenie" and by the regular publication of "Trudy Vsesoyuznogo Éntomologicheskogo Obschestva".

In general, the Society can take an important part in determining the most important and immediate scientific tasks and the direction of research both of national and of regional significance, and in fostering the relationship of science with life and practice. It would be worthwhile to make even a modest attempt at coordinating work in the field of scientific research, but many difficulties stand in the way of this.

Summing up the most important tasks of Soviet entomology and related branches, we should first of all mention the need to increase its efficacy and significance in culture and practical work. In this connection it is essential to eliminate the most serious shortcomings and to carry out a series of organizational measures; some of its primary tasks arise out of this. These include first of all, the supplementing and replacement of the basic scientific equipment in research institutes of various type— institutes, stations, departments of higher educational institutes, etc., with the wide introduction of modern instruments and the application of the advances made in physics, chemistry, and biology. Another essential is the expansion and improvement of the training of entomological personnel in universities, agriculture and medical high schools; the setting-up of an institute for completing the training of specialists in the fields of plant protection, medical and veterinary entomology and parasitology in one of the large entomological centers; and the extension of postgraduate training for special fields of entomology where a shortage exists. It would be worthwhile to start up a scientific and theoretical journal "Problems of Plant Protection".

The outstanding progress of our country and people, fired by the idea of re-creating society and united in the great purpose of constructing communism with its humanistic principles, has opened up boundless prospects for the development of science and for enhancing its role in the advance of national culture, in raising the productivity of industry, and in the care of human health. This new historical stage of development of human society is stimulating creative social forces and is providing prospects for the enhancement of the role and importance of scientific societies, one of which is the All-Union Entomological Society.

One clear aim confronts our Society — the further unification of the entomological forces of the country and the fostering of the development of Soviet entomology in all its varied special branches. This is the Society's great, basic and worthy national function.

ON THE ORIGIN OF THE INSECT FAUNA OF THE CRIMEA

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The problem of the origin of the Crimean fauna, and in particular the fauna of the Crimean mountains, has been considered by many research workers who have put forward very different opinions regarding it. The Crimean fauna present to us an intricate complex of strata of various ages and different origins beginning at the Upper Jurassic and the Chalk, when dry land first appeared. Moreover, the problem is greatly complicated by the opinions of geologists and of many zoologists concerning the relation of the Crimean mountains with those stretches of dry land lying to the south of the Black Sea.

The following theories on the origin of the Crimean fauna and flora have been expressed by zoologists and botanists: Caucasian (Keppen, Nikol'skii, Shugurov), Balkan (Aggeenko, Semenov–Tyan–Shanskii), South Russian (Sapegin, Taliev, Kobelt), a complex, principally of Asia Minor (Puzanov), a complex, principally Trans-Caucasian (Prokudin). The majority of the opinions favor the idea that the Crimean fauna are the result of natural causes, but the South Russian theory assumes that the presence of a rich complex of European mountain forest and Mediterranean forms in the Crimea resulted through introduction and transport by man. As can be seen below, our conclusions tend toward those expressed by I. L. Puzanov, based on the study of terrestrial molluscs, and by N. Prokudin, based on the study of Crimean grasses.

The Crimean is divided into the following natural geographical areas: 1) the Crimean mountains, into which the Mediterranean zone penetrates, including forests of woody juniper and Crimean pine, oak hornbeam and beech forests and forests of the pine Pinus hamata together with mountain–steppe slopes and the exposed regions of the mountain peaks and mountain pastures; 2) the Crimean steppes which comprise the Artemesia, Festuca–Stipa steppes of Prisivash'ya, the stony steppe of the Tarkhankutsk Peninsula, the Festuca–Stipa and the mixed grass Festuca–Stipa steppes of the Crimean plain (the whole of it tilled), and the Kerch Peninsula. Finally, the coastline which represents a group of interzonal biocenoses of Mediterranean character must be considered.

Although various zoogeographical elements enter into the formation of all the biocenoses, each is characterized by the predominance of one or other of these elements having a specific area of distribution. The following very important types of distribution areas among the insect fauna of the Crimea are described below in a somewhat generalized form:

1. Cosmopolitan species and species occurring in several zoogeographical regions. Predominantly mesophiles and euribionts, for example, the following: Enicmus minutus L., Trox scaber L., Rhyssemus germanus L., Aphodius granarius L., Pyrameis cardui L. Here also are included a number of synantropes, the universal distribution of which is secondary and linked with man's activity (Oryzaephilus surinamensis L., Calandra granaria L.).

2. Holarctic. Predominantly mesophiles, hygrophiles and euribionts, to which belong the following: Elaphrus riparius L., Clivina fossor L., Bembidion lampron Hrbst., B. dentellum Thunb., B. quadrimaculatum L., B. assimile Gyll., Trechus rubens F., Badister bipustulatus F., B. peltatus Panz., Hippodamia tredecimpunctata L., Adalia bipunctata L.

3. Southern Palaearctic–Indo-Malayan species. A few groups to which the following, for example, belong: Scarites terricola Bon., Microlestes plagiatus Duft., Zuphium olens F.

4. Trans-Palaearctic. Mostly euribiouts, mesophiles, hygrophiles for example: Carabus granulatus L., Bembidion varium Ol., B. obliquum Sturm., Synuchus nivalis Panz., Dolichus halensis Schall., Agonum assimile Payk., Pterostichus niger Schall., P. vulgaris L., Harpalus tardus Panz., Lebia crux-minor L., Aphodius fossor L., A. haemorrhoidalis L., A. fimetarius L., A. prodromus Brahm, A. sphacellatus Panz., A. luridus F., Potosia metallica Hrbst., Prosternon tessel latum L., Elater anguinolentus Schr., Adonia variegata Goeze, Coccinula quattuordecimpustulata L., Propylea quattuordecimpunctata L.

5. Northern Palaearctic species. (occurring principally in the north of Europe and in Siberia). Mesophiles, not numerous in the Crimea, for example: Patrobus assimilis Chaud., Dromius longiceps Ol., Synodendron cylindricum L., Onthophagus gibbulus Pall.

6. Species with disrupted areas of distribution, occurring in Europe, sometimes as far as central Asia and on to the Far East. A few groups which, for example, include the following: Calosoma inquisitor L., Acupalpus dorsalis F., Metabletes pallipes Dej., Drypta dentata Rossi, Agrilus angustulus Ill., Elater ochropterus Germ.

7. European species widely distributed in the East as far as Baikal, Transbaikal and Yukut. Mesophiles and hygrophiles. As example the following are mentioned: Carabus clathratus L., C.cancellatus L., Bembidion quadriguttatum F., Calathus melanocephalus L., Agonum gracilipes Duft., Pterostichus vernalis Panz., Amara similata Gyll., A. communis Panz., A. fulva Deg., Ophonus rufipes Deg., Harpalus fuscipalpis Sturm, H. anxius Dutt., Aphodius brevis Er., A. distinctus Müll., Onthophagus nuchicornis L., Amphimallon solstitialis L., Cetonia aurata L., Ancylocheria rustica L., A. haemorrhoidalis Hrbst., Agrilus viridis L., Selatosomus latus F.

8. European species occurring in the east as far as western Siberia inclusive. Mesophiles and hygrophiles, for example: Carabus convexus F., Leistes ferrugineus L., Asaphidion flavipes L., Bembidion ustulatum L., Panagaeus crux-major L., Licinus depressus Payk., Oodes helopioides F., Chalenius tristis Schall., Calathus ambiguus Payk., Pterostichus cupreus L., Amara eurynota Panz., Ophonus punctulatus Duft., Harpalus serripes Quens., H. picipennis Duft., Lebia cyanocephala L., Maladera holosericea Scop., Dicerca aenea L., Agriotes sputator L., A. lineatus L., Athous haemorrhoidalis F., Aromia moschata L., Rhynchites auratus Scop.

9. European species occurring beyond the Urals only in central Asia or in the steppes of Kazakhstan. Mesophiles, hygrophiles and xerophiles. Here, for example, are mentioned: Calosoma sycophanta L., Tachys bistriatus Duft., Trechus quadristriatus Schrank, Badister unipustulatus Bon., Licinus cassideus F., Callistus lunatus F., Chlaenius nitidulus Schrank, Ch. vestitus Payk., Ophonus sabulicola Panz., O. brevicollis Serv., O. azureus F., Harpalus servus Duft., Stenolophus teutonus Schrank, S. discophorus F.-W., Brachynus crepitans L., Aphodius varians Duft., A. scrofa F., Heptaulacus sus Hrbst., Onthophagus taurus Schreb., O. verticicornis Laich., Copris lunaris L., Coenorhinus aequatus L., Rhynchites bacchus L.

10. European species not occurring eastwards beyond the Urals. Mesophiles and hygrophiles, for example: Stomis pumicatus Panz., Amara lucida Duft., Diachromus germanus L., Dronius linearis Ol., Cymindis humeralis F., Lucanus cervus L., Dorcus parallelopipedus L., Aesalus scarabaeodes Panz., Aphodius hydrochoeris F., Valgus hemipterus L., Potosia affinis Andersch, Anthaxia aurulenta F., Melanotus brunnipes Germ., Cerambyx cerdo acuminatus Motsch., C. scopolii Fuessl., Rhopalopus clavipes F., Plagionotus arcuatus L., Purpuricenus kaehleri L., Mesosa curculionoides L., Batophila fallax Ws., Phyllobius contemptus Stev.

11. European species occurring in Europe to the southwest or to the extreme west of the European parts of SSSR (sometimes met with sporadically in various localities in eastern Ukraine), in the Crimea and in Caucasia. The Crimean and Caucasian parts of the distribution areas are generally separated from the European. Fundamentally mesophiles and hygrophiles Here are mentioned the following: Notiophilus germinyi Fauv., Bembidion tetragrammun Chaud., Amara anthobia Villa, Zabrus tenebrioides Goeze, Ophonus rupicola Sturm, O. subquadratus Dej., O. cupreus Dej., Harpalus atratus Latr., H. melancholicus Dej., Acupalpus interstitialis Reitt., Brachynus scopelta F., Aphodius scybalarius F., A. porcus F., Onthophagus lemur F., Adelocera punctata Hrbst., Isotomus speciosus Schneid., Stenostola ferrea Schrank, Hermeophaga mercurialis F., Rhynchaenus fagi L., Melanargia galathea L., Satyrus circe F., S. hermione L., Pararge megaera L.

12. European species with similar distribution areas but not occurring further eastwards than the Crimea. Here, for example, are included the following: Carabus intricatus L., Limnaeum nigropiceum Marsh., Licinus silphoides Rossi, Aphanistictus pusillus Ol., Chrysomela orichalcea Müll.

Many species are related to Mediterranean groups; here are included thermophiles, forms which have, for the most part, little resistance to cold, such as both hygrophiles and mesophiles, and xerophiles. We deal with these groups.

13. Ancient Mediterranean (or Southern Palaearctic). Occurring from the western boundaries of south Europe (often in North Africa) to middle and central Asia, sometimes to Kitaya. A few species penetrate northwards to the steppes and even as far as the wooded steppes. For example, the following are mentioned: Mantis religiosa L., Anacridium aegyptium L., Dyschirius chalceus Er., Tachys fulvicollis Dej., T. scutellaris Steph., Pogonus iridipennis Nic., Chlaenius spoliatus longipennis Motsch., Ch. cruralis F.-W., Carterus calydonius Rossi, Acinopus ammophilus Dej., Amblystomus metallescens Dej., Lebia trimaculata Vill., L. scapularis Geoffr., Cymindis variolosa F., Polystichus connexus Geoffr., Brachynus exhalans Rossi, Scarabaeus sacer L., Gymnopleurus mopsus Pall., Oniticellus pallipes F., Copris hispanus L., Acmaeodera flavofasciata Pill., Capnodis tenebrionis L., C. tenebricosa Ol., Meliboeus amethystinus Kiesw., Heterodorus crucifer Rossi, Drasterius bimaculatus Rossi, Henicopus pilosus Scop.

14. Mediterranean species with the same distribution areas but not occurring eastwards further than Caucasia and Iran. Here, for example, are mentioned: Tylopis lilliifolia F., Arachnocephalus vestitus Costa, Discoptila fragasoi Bol., Dociostaurus maroccanus Thunb., Haploembia solieri Ramb., Scarites laevigatus F., Dyschirius luticola Chaud., Bembidion dalmatinum Dej., B. subfasciatum Schaud., Pogonus pallidipennis Dej., P. litoralis Duft., P. meridionalis Dej., Chlaenius dejeani Dej., Ch. velutinus Duft., Atranus collaris Men., Ditomus obscurus Dej., Carterus dama Rossi, Acinopus picipes Ol., Harpalus pygmaeus Dej., Anthracus longicornis Schaum, Lebia humeralis Dej., Cymindis axillaris F., C. scapularis Schaum, Pleurophorus laevistriatus Perris, Aphodius scrutator Hrbst., A. suarius Fald., Onthophagus lucidus Ill., Chironitis hungaricus Hrbst., Rhizotrogus aestivus Ol.,

Phyllognathus excavatus Forst., Epicometis hirta Poda, Oxythyrea funesta Poda, Perotis lugubris F., Sphenoptera antiqua Ill., Crathomerus hungaricus Scop., Anthaxia polychloros Ab., A. cichorii Ol., A. hypomelaena Ill., A. fulgurans Schrank, Ptilophorus dufouri Latr., Megopis scabricornis Scop., Hesperophanes sericeus F., Cerambyx miles Bon., Stenopterus rufus L., S. ater L., Polydrosus thalassinus Gyll., Brachycerus junix Licht., Libythea celtis Fuessl., Deilephila nerii L., Celerio nycea Prünner.

15. Eastern Mediterranean species occurring from the Balkan Peninsula to Middle Asia. Here, for example, are included: Pogonus persicus Chaud., P. punctulatus Dej., P. rufoaeneus Dej., Chlaenius aeneocephalus Dej., Acinopus laevigatus Men., Brachynus bipustulatus Quens., Agrilus sericans Kiesw., Paracylindromorphus subuliformis Mannh.

16. Eastern Mediterranean species occurring from the Balkan Peninsula to Caucasia, sometimes as far as Kopet-Dagh or western Kazakhstan, for example: Dyschirius caspius Putz., Tachys pallidus Reitt., Chlaenius decipiens laticollis Chaud., Ch. terminatus Dej., Harpalus saxicola Dej., Cymindis lineata Quens., Onthophagus fissicornis Kryn., Onitis Damoetus Stev., Rhizotrogus aequinoctialis Hrbst., Anoxia pilosa F., Blitopertha lineata F., Anisoplia austriaca Hrbst., Pentodon idiota Hrbst., P. sulcifrons Küst., Amphicoma bombyliformis Pall., Cyphosoma euphraticum Cast., Anthaxia godeti Cast., A. bicolar Fald., A. olympica Kiesw., Alaus pareyssi Stev., Agriotes gurgistanus Fald., Melanotus fasciceps Gyll., Cardiophorus decorus Fald., Dasytiscus affinis Mor., Cerambyx dux Fald., Cossyphus tauricus Stev., Phytoecia praetextata Stev., Coptocephala chalybaea Germ.

17. Eastern Mediterranean species occurring from the Balkan Peninsula to Asia Minor and the Crimea, but absent from Caucasia. Here, for example, a few species are mentioned: Anoxia orientalis Kryn., Anthaxia croesus Vill, and a few others.

18. Eastern Mediterranean species occurring in the Crimean, Asia Minor and Caucasia but absent from the Balkan Peninsula. For example: Zabrus morio Men., Ophonus convexicollis Men., Potosia speciosa Adams, P. cuprina Motsch., Elater pulcher Baudi, Leiopus femoratus Fairm.

19. Species occurring in the Crimea and the Balkan Peninsula but not discovered in Asia Minor, for example: Bembidion euxinum Apf., Pogonus convexicollis Chaud., Agonum angustatum Dej., Harpalus euchlorus Men., Athous tauricus Cand., Mecynotarsus fausti Seidl., Laena pulchella F.-W., Stenosis quadraticollis Desbr., Gynandrophthalma hypocrita Lac.

20. Species occurring in the Crimean and Asia Minor (not discovered in the Balkan Peninsula and Caucasia). A group, not rich in species, including, for example: Harpalus albanicus Reitt., Cymindis ornata F.-W., Trichius orientalis Reitt., Longitarsus jailensis Heik.

21. Species occurring in the Crimean and Transcaucasia (Lesser Caucasia), often in the eastern parts of Asia Minor and Iran. Sometimes, as a result of subsequent migration, widely distributed in Caucasia as far as its northwestern parts. Here, quite a number of species are included from which one can mentioned: Bembidion heydeni Ganglb., Platyderus umbratus Men., Pterostichus advenus Quens., Eriotomus caucasicus Dej., Aphodius latisulcus Reitt., Ochodaeus integriceps Sem., Blitopertha arenicola Muls., Dicerca chlorostigma Mannh., Horrimantus tauricus Germ., Morimus verecundus Fald., Otiorrhynchus lederi Stierl., Polydrosus ponticus Fst.

22. Species occurring in the Crimean and in southwest Caucasia. Here a few species are included, for example: Holochelus subseriatus Reitt., Chalcophora proscheki Obenb., Anthaxia mamaj Plig., Acmaeodera circassica Reitt.

23. Species occurring in the Crimea and in the Ukraine (the greater part of which are sporadically met with in south or central Ukraine). The number of species is not great; from them the following are referred to: Ameles taurica Jak., Isophya brunneri Ret., Asiotmethis taurica Tarb., Epimecellus cyllocoroides Reut., Brachynotocoris puncticornis Reut., Amara chaudoiri Putz., A. deserta Kryn., A. kribricollis Chaud., Otiorrhynchus asphaltinus Germ., Polydrosus pliginskii Reitt.

24. Species endemic to the Crimea. Although the percentage of these species in the Crimea is not great, the numbers of species in the various systematic groups are generally quite considerable. For example, one can refer to: Phyllodromica Kiritshenkoi B-Bienko., Ph. retovskii Krauss, Ph. adusta F.-W., Isophya taurica Br.-W., Poecilimon boldyrevi Mir., P. tauricus Ret., P. pliginskii Mir., P. bey-bienkoi Tarb., P. Kuznetzovi Mir., Procerus scabrosus tauricus Bon., Carabus dejeani Fisch., Bembidion guttulatum Chaud., Ocys pseudopaphius Reitt., Trechus jailensis Winkl., T. tauricus Plig., T. Jacobsoni Plig., Laemostenus schirmeri Chaud., L. koeppeni Motsch., Pterostichus lyroderus Chaud., Amara taurica Motsch., Ophonus obscuripes Motsch., Harpalus mitridati Plig., Demetrias rufilabris F.-W., Brachynus sulcatulus Motsch., Rhizotrogus tauricus Blanch., Homaloplia kiritshenkoi Medv., Acmaeodera reflexomargo Reitt., Sphenoptera pliginskii Obenb., Athous tartarus Cand., Pedinus strigicollis Reitt., P. problematicus Rchdt, Opatrum triste Stev., Cryptocephalus biguttulus Suffr., C. rufilabris Suffr., Chrysomela pliginskii Reitt., Ch. taurica Breit., Cecchiniola platyscelidina Jacobs., Derocrepis serbica jajlensis Heik., Otiorrhynchus atronitens Form., O. puncticornis Gyll., O. vitis Gyll., O. infensus Fst., Eusomus jajlensis L. Arn., Satyrus euxinus Kuzn.

A fairly large number of species is related to the Pontiac group. These species, according to their origin, are related to the Mediterranean but their formation took place as a result of advantageous conditions prevailing in dry, exposed areas (although among them are found mesophiles and hygrophiles evolved under humid conditions) in southeastern Europe and Kazakhstan. Here are mentioned:

25. Pontiac species occurring from central or eastern Europe as far as the steppes of Kazakhstan and parts of southern Siberia. Predominantly xerophiles, to a lesser degree mesophiles and hygrophiles. For example: Eucharthippus pulvinatus F.-W., Psallopsis kirgisicus Reut., Cicindela atrata Pall., C. besseri Dej., C. elegans F.-W., Carabus bessarabicus F.-W., Calosoma denticolle Gebl., Ophonus steveni Dej., Harpalus amplicollis Men., Amphicoma vulpes F., Anisoplia segetum Hrbst., A. agricola Poda, Homaloplia spiraeae Pall., Malachius cornutus Gebl., Coptocephala apicalis Lac.

26. Pontiac species occurring basically on the steppes of eastern Europe (not further than western Kazakhstan), for example: Platypygius crassus Karny., Chorosomella jakovlevi Horv., Hadrophyes sulphurella Put., Paredrocoris pectoralis Reut., Hyalochiton komarovi Jak., Hyoidea notaticeps Reut., Carabus campestris Fisch., Notiophilus laticollis Chaud., Taphoxenus gigas F.-W., Pseudotaphoxenus angusticollis F.-W., Glaresis rufa Er., Aphodius sulcatus F., Anisoplia zwicki Fisch., A. brenskei Reitt., Potosia hungarica hungarica Hrbst., Sphenoptera substriata Kryn., Sph. basalis Mor., Meliboeus subulatus Mor., Agrilus zigsag Marsh.

27. Mediterranean species. Numerically a small group but very characteristic to the Crimea. For the most part they are xerophiles but there are many halophiles. For example, the following are mentioned: Bolivaria brachyptera Pall., Stibaropus henkei Jak., Cardioderus chloroticus F.-W., Pogonus orientalis Dej., P. angustus Gebl., Pterostichus subcoeruleus Quens., P. crenuliger Chaud., Amara tescicola Zimm., A. saxicola Zimm., A. abdominalis Motsch., Cymindis decora F.-W., C. picta Pall., Mastax thermarum Stev., Brachynus cruciatus Quens., Trox eversmanni Kryn., Pleurophorus variolosus Kol., Aphodius aequalis A. Schm., Polyphylla alba Pall., Anomala errans F.

The correlation between the principal elements of the Crimea is shown in the table together with examples of individual families of beetles.

Although the relationships between the individual elements in the various systematic groups differ, in all cases the Mediterranean (in particular the family Buprestidae) and European species predominate. Pontiac species are evenly represented by a small number of species, the central Asiatic by only a few. The groups of species with wide areas of distribution (Cosmopolitan, Trans-Palaearctic and others) are few; they are represented by euribionts, mesophiles, and hygrophiles. They predominate among the European species. Xerophiles are numerous among the Mediterranean species and predominate in the Pontiac and central Asiatic species.

The Crimean endemic species, which are well known among the most varied systematic groups, are of special interest. Here also gravitate certain species of Crimean origin, which have comparatively recently spread into the northwest part of Caucasia and in the Ukraine (see above). Among them there are endemic subspecies (for example, Procerus scabrosus tauricus Bon.), and species, which, because the problem has not yet been developed, are still far from being accounted for. Also well known is a monotypical endemic genus (Cecchiniola Jacobs.), but since its representatives lead very concealed lives (in the hollows of trees) it is possible that other species of the same genus will be found somewhere in Caucasia or Asia Minor.

In the larger systematic groups, the endemics fluctuate within the limits of 1-4.1%. Thus, in the family Carabidae, out of 369 species 15 (4.1%) are endemic, out of 60 species of Buprestidae, 2 species (3.3%) are endemic, out of 138 species of Lamellicornia, 2 (1.45%) are endemic, out of 101 species of Rhopalocera, 1 (almost 1%) is endemic. Nevertheless, in individual families and

Zoogeographical elements	Carabidae		Buprestidae		Lamellicornia	
	number of species	%	number of species	%	number of species	%
1. Cosmopolitan	1	0.3	–	–	3	2.2
2. Holarctic	16	4.4	–	–	–	–
3. Southern Palaearctic–Indo-Malayan	2	0.6	–	–	–	–
4. Palaearctic	30	8.2	2	3.4	22	16.0
5. Mediteranean	135	37.4	12	20.0	47	34.0
6. Pontiac	153	42.4	40	66.7	50	36.2
7. Central Asian	10	2.8	6	10.0	11	8.0
8. European	13	3.6	–	–	5	3.0
Total	369	100.0	60	100.0	138	100.0

genera, in which weakly vagile species with small areas of distribution predominate, the number of endemics may be considereably higher. For example, out of 6 grasshoppers of the genus Poecilimon occuring in the Crimea, 5 species (83.3%) are endemic; yet the abundance of Crimean endemics here is not linked with the past isolation of the Crimean Peninsula, as in other countries having species of the same genus and characterized by a high endemicity. Thus, from 72 species of this genus occurring in central and southern Europe, western and central Asia and Siberia, there are 13 endemics in the Balkan Peninsula, 25 in Asia Minor, 4 in Lesser Caucasia and Turkish Armenia, 6 in Greater Caucasia, 1 in Turkmen (Kopet-Dagh) and 1 in the Ukraine (Bei-Bienko, 1958). In this way, the endemics in the Crimean fauna are generally few in number and hardly exceed species limits. The majority of the Crimean endemics have ties of relationship with the eastern Mediterranean. At the same time, the majority of them are related in their own distribution with the Crimean mountains and only a few with the lowlands.

Members of one or other zoogeographical elements are represented in the different biocenoses but individual biocenoses or groups of related biocenoses are characterized by the presence of predominance of definite elements. The following particulars are relevant here:

1. Together with widely distributed forms (Holarctic, Trans-Palaearctic and others) Mediterranean species are richly represented (Bembidion subfasciatum, Pogonus sp. sp., Dyschirius sp. sp., Bledius sp. sp., Baeckmanniolus dimidiatus Ill., Psammobius basalis Muls., Anoxia orientalis Kryn., Ammobius rufus Luc., Trachyscelis aphodioides Letn., Phaleria pontica Sem., Belopus procerus Muls., B. tibialis Zouf. Besides these species, there are certain central Asiatic representatives inhabiting the sandy shores (Stibaropus henkei, Polyphylla alba, Anomala errans).

2. In the Mediterranean zone of the southern coast, among undergrowth of Christ's thorn and other brushwood, on exposed xerophytic areas on the lower slopes of the mountains and also in river valleys with tamerisk undergrowth, Mediterranean species, principally xerophiles predominate (Haploembia solieri, Opatrum triste, Cossyphus tauricus, Euchloe belia Cram., Thestor callimachus Ev.), and in more humid localities mesophilous representatives of the Mediterranean fauna (Anacridium aegyptium, Procerus scabrosus tauricus). Besides that, Pontiac species and certain European forest mesophiles are fairly well represented.

3. In the rare juniper forests, the fauna has the same zoogeographical and ecological characters as the preceding biocenose.

4. On the mountain-steppe slopes with Stipa, xerophiles predominate, both Pontiac (Saga pedo Pall, Tentyria taurica Tausch., Pedinus tauricus Muls., Coptocephala apicalis, Amphicoma vulpes F., Gnator spinimanus Pall), and Mediterranean species (Henicopus pilosus, Brachycerus junix).

5. In the Crimean pine forests Mediterranean xerophiles and mesophiles play a very large role; certain representatives of this complex are connected with the Crimean pine (Chalcophora proscheki, Anthaxia godeti, A. mamaj). European mesophiles are somewhat more numerous here than in the foregoing biocenoses; Pontiac species are adapted to arid areas. There are a few endemics of Mediterranean origin (Homaloplia kiritshenkoi).

6. Oak-hornbeam forests are characterized by a predominance of European fauna, although mesophilous and dendrophilous Mediterranean fauna are also well represented. The majority of the endemics are the same as in the preceding biocenoses, but a few (for example, Opatrum triste) are not found here. Widely occurring mesophiles are fairly numerous and there are a few Pontiac species.

7. Beech forests, according to the composition of the zoogeographical elements and ecological groups, are related to the preceding biocenose but the European fauna is better represented. The presence in this complex of species biologically connected with the beech tree (Anobium fagi Muls., Rhynchaenus fagi L., Rosalia subsignatus Boh.), is characteristic. In the glades in the upper zone of beech forests certain species characteristic to mountain pasture (Derocrepis serbica jajlensis, Argoptochus subsignatus Boh.) are already met with.

8. Forests consisting of Pinus hamata are characterized by the predominance of European forest mesophiles, by the presence of certain Holarctic Trans-Palaearctic and northern Palaearctic forms together with a comparatively small number of Mediterranean species. Into the upper part of the zone solitary representatives of the mountain pasture fauna intrude. The general character of the fauna is mesophilous.

9. On mountain pasture there are representatives of Pontiac forms – inhabitants of the steppes, among which is Erebia afer Esp., whose basic area of distribution is from beyond the Volga, on the steppes of Kazakhstan. The European meadow fauna and even the forest mesophiles (Drilus concolor Ahr., Lampyris noctiluca L., Troglops albicans L., Batophila fallax Wse.), are quite well represented, also single members of the European fauna (Argoptochus subsignatus, Scleropterus serratus Germ.) and of the mountain fauna of Asia Minor (Longitarsus jajlensis) together with a number of endemics adapted to mountain pasture. (Pendinus problematicus, Chrysomela pliginskii, Ch. taurica, Derocrepis serbica jajlensis, Otiorrhynchus puncticornis, Gymnetron sp., Eusomus jajlensis).

10. The same geographical elements and ecological groups as in the corresponding steppes of the Ukranian mainland are, in general, found on the mixed grass–Festuca–Stipa and the Festuca–Stipa grass steppes of the Crimean lowlands; European and Pontiac species predominate (xerophiles and stepped mesophiles); the number of Mediterranean species is greater than on the steppes of the Ukranian mainland; as in the latter there is a certain number of central Asiatic widely distributed species.

There are a few endemics (Harpalus mitridati Plig., Dorcadion mokrzeckii Jak.—on the Kerch Peninsula). A number of species occuring on the steppes of south Ukraine are absent (Satyrus briseis L., Triphysa phryne Pall. and others).

11. The stony steppe on the Tarkhankutsk Peninsula is similar to the Festuca—Stipa grass steppe of the Crimea. As with the widely distributed species of those steppes, inhabitants of the stony, alluvial deposit steppe zone of the Ukraine (Malachius cornutus Gebl.) are met with here, as well as certain species characteristic of the Crimean mountains. Cryptocephalus apicalis Gebl. is found here ab. rimskii Jacobs. but in other places in the Ukraine it is very rare.

12. The Artemesia—Festuca—Stipa steppe of Prisivash'e is not different from the corresponding steppe of the northern shores of the Sivash Sea. Like the European and Pontiac elements,the Mediterranean element plays the greater role here; the middle Asiatic species are better represented than on the grassy steppes.

13. In the salt marshes of Prisivash'e European and widely distributed meadow mesophiles, Pontiac, Mediterranean and relatively numerous central Asiatic species are represented; among the latter are many halophiles.

14. The zoogeographical groups of insects belong to various geological ages and at various times penetrated into the Crimea or were formed on the spot. It is probable that widely occurring mesophiles and hygrophiles—cosmopolitan, Holarctic and Trans-Palaeoarctic appeared with the ancient groups. It is possible that some of them already existed in the Palaeogene, although basically it appears that in age they go back to the Miocene. Such species populated the Crimea step by step as it was liberated from the sea. It is probable that during the Miocene there already existed a littoral fauna which was relatively static and was preserved until present times. Various species of Cicindela, Carabidae, Bledius, Heterocerus, Baeckmanniolus dimidiatus, Psammobius basalis, P. laevipennis Costa, Phyllognathus excavatus; Anoxia orientalis, Phaleria pontica, Ammobius rufus are concerned here. Mediterranean forest mesophiles were also formed during the Miocene and migrated into the Crimea from the dry land located to the south.

One must suppose that during the various ages the migratory routes of insects and the colonization of the Crimea by them were different, but taking into consideration that until the Upper Pliocene (Cimmerian epoch) there was no continental bridge from the Crimean mountains to the dry land to the north, such colonization was possible only from the south. Coexisting with many widely distributed Mediterranean species which were able to penetrate into the Crimean from various directions were, as already noticed, certain groups of eastern Mediterranean species having narrow distribution areas (east Mediterranean, except the Balkan Peninsual, or Caucasia Crimean-Caucasian, Crimea-Asia Minor, Crimea-Balkan Peninsula). At the same time one should have in mind the pairs of closely related, representative species (the Crimean Carabus dejeani F.-W., and the North Balkan C. creaticus Dej., the Crimean Holochelus subseriatus Reitt. and H. lineolatus Reitt.). The presence of such pairs of species points to the possibility of their having been a few waves of colonization into the Crimea from the south. Judging from the number of common species, the Crimean mountains had a definite connection with Trans-Caucasia (Lesser Caucasia) and with the eastern part of Asia Minor. Nevertheless, it is possible to name many insect species and their individual subgenera and genera—typical representatives of the Caucasian fauna—which are absent from the Crimea; for example, Proserus caucasicus Adams., the subgenera Plectes, Microplectes, Sphodristocarabus, Aulacocarabus, Tribax, the genus Carabus, the genera Tanyproctus, Glaphyrus, the species Lucanus ibericus Motsch., Platycerus caucasicus Parry, Aesalus ulanovskii Ganglb., Anomala abchasica Motsch., Melolontha aceris Fald., M. pectoralis Germ., M. permira Reitt., Hoplia pollinosa Kryn., Oxythyrea cinctella Schaum, Trichius fasciatus L., Gnorimus bartelsi Fald., Gymnopleurus coriarius Hrbst., Resus serricollis Motsch., Strangalia jaegeri Humm. and many others. Their absence from the Crimea may depend on various causes: firstly, the locality in which a number of species was formed might have been Greater Caucasia which had no connection with the Crimean mountains (Procerus caucasicus, Plectes, Tribax, Melolontha permira, Gnorimus bartelsi); secondly, the formation and distribution of a number of species might pertain to more recent times when there was no connection between the Crimea and the areas mentioned above; thirdly, for some species, ecological conditions were not suitable; fourthly, it is possible that some species became extinct, particularly in the Pleistocene period.

A number of species come from the central parts of Asia Minor (Trichius orientalis, the ancestral species Holochelus subseriatus, Longitarsus jajlensis), but they were able to penetrate only through the southern part of it; also able to enter by devious routes were a number of Crimean—Balkan endemics unknown in Asia Minor where, bearing in mind that the Turkish fauna are still not adequately investigated, they could subsequently be lost to view, or still exist but not be discovered. Nevertheless, some of the species of this complex were able to enter the Crimea considerably later from the west through Dobrudzhu, possibly in the Kujalhitsky age when a broad continental bridge connected the Crimea with the dry land lying to the north and west of it. The infiltration of a few of these species into the Crimea from the south or southeast is upheld by the fact that the Little Asiatic species Trichius orientalis was found there but not the very closely-related Balkan species T. sexualis Bed. This also shows that at that time both species were already independent.

In the mesophilous forest fauna of the Crimea there are not very many genera and species which occur in the

Balkan Peninsula and in Asia Minor, for example: Melolontha, Triodonta, Elaphocera, Osmoderma, Gnorimus, Propomacrus bimucronatus Pall., Pseudotrematodes frivaldszkyi Men., Potosia venusta Men., Chromovalgus peyroni Muls. (the latter only in Asia Minor). Their absence in the Crimea can be explained only partially by subsequent extinction, probably in the Pleistocene (Propomacrus bimucronatus, Chromovalgus peyroni, Elaphocera, Triodonta), but also partially (the absence of the corresponding species on those areas of dry land where junction with the Crimea was possible, although only to a small degree) by the absence of suitable ecological conditions at that time.

In the Crimea there is a series of Mediterranean species—inhabitants of the sea shore—which are not present in Caucasia, for instance, Anoxia orientalis, Phyllognathus excavatus which only recently penetrated into the extreme north-east of Caucasia as far as Anapa. The latter was probably widely distributed along the shores of the Sarmatsk Sea, when Greater Caucasia was still an island, from which it was able to reach the country of modern Turkmen and Uzbekistan. After Caucasia had been joined to the dry land located to the south, the area of distribution of this species was disrupted with the consequence that west and east populations developed independently under considerably different conditions, which led to the formation of two distinct species—the Mediterranean Ph. excavatus and the central Asiatic Ph. hauseri Reitt. The first spread from the Iberian Peninsula and Morocco reaching to the east as far as the northern shores of the Black Sea at Anapa—to the south as far as Trebizond.

Probably, it is possible to explain its absence on the shores of Caucasia between these points only by the inadequacy of ecological conditions. As regards A. orientalis, this western Mediterranean species, occurring eastwards as far as the Crimea, Asia Minor and Syria, was probably formed and dispersed later, when Caucasia was a peninsula, which is why it does not extend along the south coast within the boundaries of Central Asia. Its absence from the Caucasian coast of the Black Sea is connected, it seems, with the absence of suitable soil in which its larva develops.

The development of the European mesophilous fauna took place to a considerable degree at the time when the Mediterranean mesophilous fauna was developed, that is, at the beginning of the Miocene. The species of this complex occur widely in the Mediterranean but at the present time they go considerably further north than the typical Mediterranean species. It may be that both these groups have a common origin but the European species differ only by the fact that they have a greater resistance to low temperatures. Up to the end of the Pliocene the entrance of such species into the Crimea could take place only in the same way as the Mediterranean mesophiles, that is, from the south. Such species at the present time are found in Caucasia and in Asia Minor (Chrysobothris affinis F, Lucanus cervus, Dorcus parallelopipedus, Cerambyx cerdo acuminatus, C. scopolii, Batophila fallax) or only in Asia Minor (Hermeophaga mercurialis F.). The distribution areas of these species in the Crimean mountains is broken from the south by the Black Sea and from the north from the forest of the Ukraine by a belt of treeless steppes.

The infiltration of species belonging to the European complex, in particular the forest mesophiles, proceeded at a much later time, but from the north it had already taken place when the Crimea was a peninsula. According to its origin there were already immigrants coming into Europe from the east with the Thurgovian flora. Usually such species are absent from Asia Minor and Caucasia.

At the expense of various ecological forms, forest mesophiles, in particular, living at the edges of forests, and also at the expense of the inhabitants of the shores, the xerophilous fauna of the savannah and steppes was formed in the Pliocene and this partially penetrated the Crimea from other countries and was formed partially on the spot. Here belong the xerophiles widely distributed in the Mediterranean and the xerophiles with a much narrower Mediterranean area of distribution. Simultaneously, the formation of the steppe, xerophilous, (and in more humid conditions—mesophilous) "Pontiac" fauna proceeded in countries located to the south of the Crimea, which was then still separated from it by a sea barrier. Consequently, until the beginning of the Cimmerian epoch the colonization of the Crimea by such forms could proceed only from the south, until the "Pontiac dry land" came into being; actually, at the present time, such species occur in Caucasia (in the district of Lesser Caucasia) and in Asia Minor or are replaced there by closely related species. Here belong Amphicoma bombyliformis, Rhizotrogus aequinoctialis, Copris hispanus, Onitis damoetas, Onthophagus fissicornis, O. lucidus, Cyphosoma euphraticum, Cossyphus tauricus, Stenosis quadraticollis, Dendarus punctatus Serv. and others. In the Cimmerian epoch, when the Crimea was temporarily a peninsula of the dry land to the north, there began a vigorous migration of Pontiac forms from the north, for example, Tentyria nomas Pall. (from which, probably, T. taurica Tausch. subsequently arose) species of Pedinus, Dorcadion, Amara, Harpalus, Anisoplia (part), and Chironitis hungaricus, Zegris eupheme Esp.

The Quaternary period was marked by glaciations alternating with the interglacial climates, which were even warmer than at the present day. The Crimea finally lost its connection with dry land located to the south of the Black Sea (still at the end of the Pliocene). Although the glaciers, even at the time of the maximum Rissian glaciation, failed by a long way to reach the Crimea they exerted a decided influence on the climate and, through the latter, on the insect fauna. It is probable that in the Pleistocene period many representatives of the subtropical fauna became extinct and a few

species became restricted in distribution (Alaus pereyssi, Cyphosoma euphraticum and others. As a result of isolation and life under changing conditions many representatives at that time produced separate species or subspecies, for example Procerus scabrosus tauricus (descended from P. scabrosus Ol.), Carabus dejeani F.-W., Rhizotrogus tauricus (decended from Rh. vernus Germ.), Holochelus subseriatus (descended from H. lineolatus), Tentyria taurica (descended from T. nomas), Pedinus problematicus, Opatrum triste.

The infiltration into the Crimean mountains of a number of European meadow species and north Palaearctic species took place possibly at the time of the Rissian and Wurmian glaciations, when the south Ukraine was characterized by birch-wooded steppes. Similarly, at this time, conditions were satisfactory for the infiltration of large complexes of similar forms which, at present, are widely distributed, not only in the Taiga zone (the vast Siberian forest) but in the broad-leaved forests of the greater part of Europe or, at any rate, its eastern portion, for example; Ceruchus chrysomelinus Hochw., Phyllopertha horticola L., Melolontha hippocastani F., Amphimallon altaicus Mannh., Lasiopsis caninus Zoubk., Trichius fasciatus L., Potasia- lugubris Hrbst., Upis ceramboides L., Limenitis populi L., Vanessa antiopa L. These species are absent not only in the Crimean mountains, but also in the oak - birch - aspen cut-over portions of the second terrace of the lower Dneiper and in the Kinburnsk sandbar. At the same time some of these species (Aeropus sibericus L., Phyllopertha horticola, Lasiopsis caninus, Amphimallon altaicus, Trichius fasciatus and others) penetrated into Caucasia where they represent mountain and forest elements. Evidently, their entry into Caucasia occurred already after the Khvalynsk transgression, that is, at the end of the Wurmian glaciation.

At the time of the glaciation in the Crimean mountains a few cold-loving species were able to enter, among them representatives of alpine fauna, but owing to the absence of suitable conditions at the present time (because of the lowness of the Crimean mountains together with the low latitude), the majority of the species are now extinct here. Thus, it is quite possible to meet the Apollon butterfly (Parnassius apollo L.) a well-known inhabitant of the Siberian forest zone of Europe, Siberia and the high-altitude Alps, Karpat (Tatra), Caucasia and the mountains of Central Asia and Siberia. Yet, at the present time the alpine fauna in the strict sense of the term does not occur in the Crimea; here there are a number of species, specific to mountain pasture which may be termed subalpine (see above), some of them common to Caucasia and some to the mountains of central Europe and some endemic.

At the same time along the birch cut-over areas of South Ukraine, certain European species were able to penetrate the Crimea, but conditions were not favorable for the many forest mesophiles and that is why they scarcely enriched the Crimean fauna.

After the Wurmian glaciation, that is, in the Holocene, in Atlantic time, a large number of insect species of the central European complex—meadow and forest mesophiles—began to become widely spread to the north and east from the direction of south Europe. At that time the contemporary insect fauna of the broad-leaved forests of the European parts of SSSR were basically formed. The forests in the Crimean mountains were enriched by a number of species, principally forms living in herbaceous vegetation and meadows. Dendrophiles were also able to enter but only to a very small extent because neither in the south of Ukraine nor in the Crimean lowlands was there a continuous forest nor even large wooded mountain ranges. Only small cut-over areas of an impoverished floristic composition could at that time have a wider distribution. In connection with these special features many species were unable to penetrate into the Crimea and are absent from its mountain forests, notwithstanding the presence of favorable ecological conditions. Here, for example, belong Carabus glabratus Payk, Aphodius ater Deg., A. rufipes L., Odontaeus armiger Scop., Geotrupes stercorosus Scriba, G. vernalis L., Melolontha melolontha L., Osmoderma eremita Scop., Gnorimus octopunctatus F., G. nobilis L., Potasia aeruginosa Drury, P. fieberi Kr., Curculio nucum L., Limenitis, Apatura, Neptis lucilla F., N. aceris L., Araschnia levana L., Nemeobius lucina L.

At the same time as the mesophilous fauna (and probably flora) was widely distributed in the east of the Crimean Peninsula, many mesophiles, forest mesophiles among them, were to be found throughout the Kerch Peninsula in the northwest part of Caucasia, for example; Holochelus subseriatus (extending as far as Maikop), Chalcophora proscheki, Anthaxia godeti, A. mamaj, and, from the littoral forms, Phyllognathus excavatus (as far as Anapa). It is characteristic that all these species fly well. Consequently, there is no need to suppose that a territorial connection existed between the Kerch Peninsula and the Taman Peninsula in order to account for this dispersal; dispersion is possible over narrow expanses of water for such genera of flying insects and where similar biotopes on each side of the strait exist.

In Atlantic times many moderately xerophilous species or species intermediate between xerophiles and mesophiles (steppe mesophiles) were able to colonize the Crimea from the north. The majority of these representatives of the Pontiac and Mediterranean faunas were linked with meadow steppes and mixed grass Festuca—Stipa steppes of the Ukraine, for example; Gnaptor spinimanus Pall., Platyscelis melas Fisch., Cryptocephalus sericeus L., C. virens Suffr., Onthophagus fracticornis Preyssl. Nevertheless, certain species of this complex (for example, Lethrus apterus Laxm.) do not reach the Crimea; in all probability such species spread to the southwest from the direction of the Balkan Peninsula but met with a serious obstruction in the form of the river Dneiper, which at that time was still insurmount-

able. A gradual change towards a drier climate impeded their dissemination and may even have (in times of drought and heat) curtailed their area of distribution and forced them to the southwest.

In times of drought and heat the arid Festuca–Stipa and the Artemesia Festuca–Stipa steppes, and partly semiarid steppes, advanced a long way in the north and west directions, and at the same time many xerophiles of Mediterranean origin came from the southeast. In the beginning the inhabitants of the grassy steppes and semiarid, Pre-Caspian areas began to spread, and after that the sand and salt-marsh inhabitants: from the first are Tartarogryllus tartarus Sauss., Cicada querula Pall., Pentodon bidens Pall., Agrilus sericans, Pimelia subglobosa Pall., Cryptocephalus gamma H. S., C. coronatus Suffr., C. flexuosus Kryn., Erebia afer (penetrated to Yaila), from the semiarid psammophiles–Stibaropus henkei, Polyphylla alba, Anomala errans, from the halophiles–Gryllodinus kerkennensis Fin. (in Prisivash'ev), Gryllotalpa unispina Sauss., Mioscirtus wagneri Ev., Tarisa fraudatrix Horv., Chionesoma vulpinum Gyll. (in Prisivash'ev), Chloropterus versicolor Mor., Ischironota desertorum Gebl., Apion artemisiae Mor. and others. The Festuca–Stipa and Artemesia Festuca–Stipa steppes formed in the north of the Crimea and in South Ukraine, having occupied a far larger area than at the present time and having combined with the corresponding Pre-Caspian steppes, separated the mixed grass steppes and the wooded steppes of the foothills of the Crimea from the corresponding zones in continental Ukraine and, in consequence, many species living in these conditions but not being able to withstand severe desiccation were interrupted in their areas of distribution. A few thermophilous species, some widely distributed in the Mediterranean, and some autochthonous Crimean forms,spread to a greater or lesser degree to the north, to the boundaries of the Ukraine, for example; Ameles taurica Jak., Empusa fasciata Br.-W. Dociostaurus maroccanus, Asiotmethis taurica, Epimecellus cyllocoroides, Copris hispanus, Phyllognathus excavatus, Tentyria taurica, Stenosis quadraticollis, Otiorrhyncus asphaltinus.

One should note the absence in the Crimean sands (in Evpatori) of many psammophiles widely distributed in the Ukraine, among which from the lower Dneiper (Aleshkovski) sands are, for example; Ceratophyus polyceros Pall., Anomala dubia Scop., Monotropus nordmanni Blanch., Hoplia parvula Kryn., H. zaitzevi Jacobs., Anatolica abbreviata Gebl, A.eremita Stev. Evidently these species do not live on shell-sand shores since in South Ukraine (the maritime sand bars of Tender and Dzhalylgach) they are also absent under similar conditions. At the same time the absence of Polyphylla fullo on the shell-sand coasts of the Crimea is also unexplainable because under similar conditions it occurs abundantly in Tender.

In connection with certain periods of cooling and humidification of the climate in contemporary times, reductions in distribution areas and partial extermination of thermophilous and xerophilous species occurred; That is why the distribution areas of many species of this type, widely distributed in Prisivash'ev, are found widely separated from their original distribution areas–in the Pre-Caspian. Other species having spread from the Crimea towards the north were preserved there only in a few minor localities widely separated from one another (Otiorrhynchus asphaltinus Germ.); a third part is preserved only in the immediate vicinity of the Crimea, in Prisivash'ev (Stenosis quadraticollis, Copris hispanus, Phyllognathus excavatus); a fourth, but only on the Crimean mountain pasture (Erebia afer). Nevertheless, the distribution areas of the inhabitants of the mixed grass steppes of the Crimea were not joined to the continental part of their distribution areas such as the Festuca–Stipa and Artemesia Festuca–Stipa steppes, although the extent of their areas was reduced before separation. Certain steppe mesophiles (Lethrus apterus, Rhizotrogus vernus) (inhabitants of the mixed grass steppes) which in times of heat and drought withdrew to the west or kept to their eastern habitats, again began to extend in this direction, overcoming such obstacles as the Dneiper and partially the Don, in their middle courses; but because of the presence of belts of arid steppes in South Ukraine and North Crimea all were not able to reach the Crimean Peninsula and find localities with favorable ecological conditions.

In contemporary times,the limits of the distribution areas of many European species were formed to the east within the boundaries of the European parts of SSSR. It is quite possible that since glacial times such species were widely spread in eastern Europe,but in glacial times they died out and did not reappear in interglacial periods, and in the Holocene and Atlantic periods they were also spread in the northwest direction considerably further than at present. As a result of heat and drought,and of recent cooling,their distribution areas to the east were reduced; in one species the northeastern limits steeply diminish, in accordance with the winter isotherms at the present time, in a southeast direction (from Finsk Gulf to northern Ukraine and lower Povolzh'yu) or, similarly, to southeast Ukraine or to Moldavia and the Black Sea coast; and so in this instance the Crimean and Caucasian parts of the areas appear to be severed from the European parts. In certain species occurring in the Crimea (and often in Caucasia), both European and Mediterranean, the distribution areas in the Ukraine are repeatedly split up; these species are preserved only in separate, isolated areas (in the Donetz hills and in a few other places), frequently very far from one another. For example, one can mention Ascalaphus macaronius Scop., Satyrus circe F., Melanargia galathea L. and others.

* * *

In conclusion one should pause and consider the part played by man in the formation of the Crimean insect fauna. Stored-products insects and household insects,

widely distributed in all countries, almost without exception have been introduced into the Crimea by man. A few insects were brought in on cultivated plants introduced by man, for example: the vine phylloxera (Dactylosphaera vitifolii Fitch.), the red aphis (Eriosoma lanigerum Hausm.), the aphid Chromaphis juglandicola Kalt. (on walnut), Eriococcus buxi Fonsc. (on box), Aspidiotus hederae Vall., the pea weevil (Bruchus pisorum L.) and others. In connection with the planting of orchards and tree belts on the treeless steppes in the flat parts of the Crimea, the forest pests left their mountain hosts and certain of them became orchard pests (Rhynchites bacchus L. Coenorrhinus pauxillus Germ.). Nevertheless, not all forest insects by far were able to spread to the artificial plantings on the Crimean steppes. The majority of these species are widely distributed both in the forests of the Crimean mountains and in the forest steppe zone of the Ukraine. Typical Mediterranean forms having their northern limits in the Crimean mountains do not occur in the north because of the unfavorable climatic conditions. Linked with the plowing up of the steppes and the destruction of forests in the mountains, many insects reduced their areas of distribution and completely died out.

As a result of transport by man of insects from other localities, the fauna, to a certain degree, loses the historical character of having been formed into a natural geographical complex and conforms only to ecological laws. An analysis of the Crimean insect fauna with all the evidence available reveals a natural, geographical principle in its formation, in particular, the natural origin of its Mediterranean elements which could enter only from the south. Any attempt to explain the presence of such a rich Mediterranean faunistic complex in the Crimea by man's intervention has no basis and is unscientific.

There have also been attempts to account for the treeless tracts of the Crimean mountain pasture exclusively by deforestation and by the excessive cutting of trees. The presence in the Crimean mountain pasture of endemic species of subalpine types and also species having a widely disrupted area of distribution (Erebia afer) is convincing evidence that the fauna of mountain pasture was built up naturally over a long period and is not the result of a transitory (in the geological sense) period of man's activity.

SUMMARY

1. The Crimean insect fauna represents an intricate complex of various zoogeographical strata from the Paleogene to the Holocene.

2. It is impossible to explain the origin of the Crimean fauna unless it is assumed that within the Tertiary period (until the end of the Pliocene) the Crimea had a territorial connection with dry land to the south of the Black Sea.

3. The oldest faunistic groups in the Crimea, except a few widely distributed forms, appear to be Mediterranean forest mesophiles (widely distributed in the Mediterranean) European forest mesophiles and inhabitants of the sea coasts, the formation of which can possibly be referred to the Miocene.

4. The formation of the xerophilous Mediterranean and Pontiac fauna is, in general, referred to the Pliocene; it was produced partially on the spot and partially by means of migrations which came from the south or southeast at first, but beginning with the Cimmerian age—also from the north (after the Kujalnitzky age when the connection of the Crimea with the south ceased, only from the north).

5. In the Quaternary period, various migrations of insects into the Crimea took place from the southwest, west, north and east; from the Crimea some species migrated into the Ukraine and into the northwest part of Caucasia. It is probable that many subtropical thermophilous species became extinct during the Pleistocene period.

6. The endemicity of the Crimean insect fauna is not large and does not exceed, in general, 1—4%; in the great majority of instances it does not exceed the species limit, which shows the comparative youthfulness of the Crimean endemics, the formation of which, in general, took place in the Pleistocene.

7. The influence of man on the insect fauna of the Crimea is seen in the introduction of synantropes and certain pests of cultivated plants and also in the distribution over the steppe zone of certain dendrophiles connected with horticulture and afforestation. Man's influence on the fauna of the natural biocenoses (forest, steppe) was generally disadvantageous (extinction of a number of species with defforestation and during the plowing up of the steppes).

8. The natural origin of the Mediterranean component of the Crimean insect fauna and the fauna of the mountain pastures points clearly to a historical—geographical character.

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WHY INSECTS FLY TO LIGHT BY NIGHT

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It is well known that insects are attracted to lighted lamps at night. Lamps were used long ago for the study of the insect fauna at times when harmful insect were on the wing and, in later times, for the destruction of certain insect pests. Special luminous traps are constructed for catching insects by night, the newest models of which are equipped with mercury lamps — powerful sources of short-wave light rays (Mazokhin-Porshnyakov [1956a, 1956b, 1958]; Frost [1957] Pfrimmer [1957]).

Why do insects fly to light, generally choosing lamps rich in ultraviolet radiation? As we shall see there is no straight answer to this simple question.

From observations carried out over many years on insects flying to lamps, a number of facts have been accumulated which cannot altogether be explained by any of the hypotheses involving the mechanics of the attractive action of light. We enumerate the principal facts below.

Apparently, not all night-flying species of insects and species flying throughout the day (males of the family of moths Liparlidae, hornets, Phytometra gamma and others), fly to light to an equal degree: One does so in great numbers, another in lesser numbers. Diurnal insects rarely fly to light and probably only in those instances when they are disturbed during their nocturnal quietude. Similarly, insects fly both immediately to a source of light and to an illuminated screen, for example, an illuminated white wall. Sometimes they fly to lamps by the shortest route—direct, but they generally take a complex and irregular path. The reaction of insects to the spectrum is selective: the shorter the length of the light wave, the greater its attraction. For the majority of species, the most attractive rays are the ultraviolet, violet and blue, and the least attractive are the red rays. The number of insects flying to light drops sharply on moonlight nights. In northern latitutes, attraction to light is far poorer than in more southerly latitudes, particularly in steppes and deserts. Having flown to a source of light, the majority of insects become inactive and settle down within the limits of the zone of illumination. Often they do not fly as far as the source of light but drop down some distance away and remain quiet so long as the light does not go out. Other conditions remaining equal, the intensity of the flight to light depends upon a number of meteorological factors (temperature and humidity of the air, wind speed) but with these we shall not be concerned.

Popular among biologists is the theory of V. Buddenbrock [1917], whereby insects are attracted to light mechanically and not of their own will, describing around it a path which consists of a logarithmic spiral. Having entered the zone of illumination of the lamp, the insects from the furthest point of motion keep a steady angle φ between the direction of the incident light beam and the axis of the body (menotaxis). With certain angles of entry into the zone of light the preservation of the angle φ inevitably leads, within the radial divergence of the light rays, to the insect's taking a path in the form of a logarithmic spiral and approaching the lamp. Later on, Buddenbrock [1937] quoted the experimental results of V. Ludwig [1933] on caterpillars as experimental proof of his theory. In laboratory experiments the caterpillars actively preserved the angle φ and moved to the point source of the light along a logarithmic spiral path, but Ludwig himself [1933, 1934] did not in the least attempt to explain the light-compass reaction of other insects in the same way.

However, the elegant theory of Buddenbrock is not supported by observations in nature. Insects fly not only to a source of radially divergent rays of light (a lamp) but also to the diffuse light of a screen or to a narrow pencil of light. Their path to the lamp is not constant: now straight forward, now in a zigzag manner, and again, it would seem, chaotically. Only directly near the lamp do the insects sometimes describe circles or spirals.

Other information on the causes of the flight of insects to light has been published. According to the opinion of F. Mell [1954] a bright artificial light has a highly irritating action on night-flying insects (moths), stimulating them into activity in consequence of which they appear to fly to the light.

V. Matten [1956] compared the nature of the behavior of insects flying to light with the behavior during the day, when nocturnal insects, after being rather excitable, settle down in a darkened box. Under these conditions they fly out of the box (to the light) and do not retire to the back of the box which is dark. In other words, one says that the excited insect makes for the light. The same takes place at night when one lights a lamp. Falling into the zone of light, the insect, according to the opinion of Marten, becomes excited and in order to get away from the strange situation directs itself to the light where it seeks a darkened place for its diurnal rest.

Nevertheless, the principal idea of Marten [1956] and Mell [1954], the desire for light when in an excited state, brought forward to elucidate the cause of insects flying

to light, does not agree with the facts. It is contradicted, for instance, by observations on cockroaches and earwigs. If these are suddenly illuminated they retreat into dark places and do not crawl to the light. In addition to that both insects fly to lamps at night.

Another fruitful idea of Marten [1956] agrees very closely with the brief and undeveloped opinion of N. C. Dekthyarev[1925]. These authors speak of the desire of insects for light as an outlet from some retreat beyond the limits of which it perceives a path to unhindered flight.

Having studied the ideas of these two recent authors, we shall try to elucidate the mechanism of the flight of insects to light as we see it. The consideration of an example well known to all will assist us in this attempt. If a nocturnal moth is released in a room during the day it immediately flies to a dark corner and never to a window — the most illuminated part of a room. Under similar conditions diurnal moths will behave in an opposite manner; they turn to the light immediately and begin to crawl on the glass of the window frame trying to get free. The reason for the different behavior of these moths leaves us in no doubt. Nocturnal moths are active only at night; during the day they pass their time in concealment, avoiding light (negative phototropism). Diurnal moths are active only during the day, when they turn to light (positive phototropism). Light draws the moth to the window because it appears to be an open space. However, with the approach of evening the behavior of the moths changes; the diurnal ones cease to fly, the nocturnal ones turn to the window — above all to the illuminated parts the room. It means that, in the presence of a general diffuse light both moths (one during the day, the other in the evening) strive to reach the most illuminated place. The same behavior is noticed when a lamp is lighted in a room at night; both moths begin to gyrate round the lamp turning towards the source of light, which is brighter than the evening sky. Consequently, in the evening both moths exhibit a positive phototropism; for nocturnal moths this positive phototropism is perfectly normal but for diurnal moths it is abnormal — produced by a sudden violation of its nocturnal quietude.

Nocturnal moths behave similarly when, under natural conditions, they suddenly come upon a zone of artificial illumination. They turn towards the source of light since the brighter illumination — the sign of open space — is a path to freedom. This was once clearly seen in the behavior of a hornet which surprised us; while on the wing the hornet beat itself against a sheet (at night) lighted by a mercury lamp in the same way as a diurnal moth at a glass window.

Consequently, light attracts nocturnal and diurnal insects not by itself and not just as a source of light, but as an indication of open space or as an absence of obstruction. Open space is always better lighted than a closed one - it attracts insects so that they can more easily orientate themselves for the exercise of one or another vital function.

During their life insects constantly make use of bright illumination as indicative of space. Thus, light penetrating through holes acts as a signal showing the position of exits from hollows or other refuges. Flying out of dense vegetation, insects orient themselves in the direction of aperture among the branches through which the light of the sky penetrates. Many such examples can be quoted.

Now it is necessary to explain why short-wave light rays act on insects more strongly than rays of longer wave length. One would think that the maximum spectral sensitivity of their eyes is just in the short wave part of the spectrum, that is, the ultraviolet, violet and blue rays are brighter to insects than the yellow and orange-red. A similar conclusion is drawn by some authors who have estimated the spectral sensitivity of insects' eyes according to the attractiveness of the various light rays of the spectrum. According to experiments on the behavior of insects one cannot rigidly prove that their reactions are proportional to the stimulation of the photoreceptors and that it does not depend upon the action of one or another reflex action. For example, it is well known that the female cabbage butterfly, up to the oviposition period, is far more attracted to red and purple light (the color of flowers frequented by it) but after the ripening of the sexual products the greatest attraction comes from yellow light (the color of the leaves on which it lays its eggs; Ilse [1937]). More reliable electro-physiological experiments in which the reactions of the photoreceptors were measured directly show that the eyes of insects are maximally sensitive to the yellow (490-550 mμ rays. For confirmation of the existence of a second maximum sensitivity in the ultraviolet, which was observed by I. Walther [1957] on the fly Calliphora and the American cockroach, more careful measurements are required.

According to our opinion a stronger reaction of insects to ultraviolet rays depends not so much upon the light sensitivity of their eyes as upon the peculiarities of their life. If we compare the role that light plays in indicating open space with the spectral composition of day and night light we see that the short-wave light, particularly the ultraviolet, is above all a characteristic feature of exposed areas; light coming from exposed areas is richer in ultra-violet rays than that from closed areas. The point is that terrestrial surfaces (soil, vegetation) strongly absorb short-wave light and reflect mainly the long waves. Therefore, ordinary objects, except chalk outcrops, trunks of birch and some kinds of flowers cannot be sources of reflection for short-wave radiation. In nature the only sources of this reflection seem to be the sun and sky — orientators which certainly lead to open space. If insects oriented themselves to yellow or orange-red light rays the light would lead them on a wrong path : instead of leading into open space it would lead to a surface reflecting those rays.

During the day the sources of ultraviolet, violet and blue light rays appear to be the sun and sky : the atmosphere scatters light, principally short-wave light (beginning with λ 300—310 mμ) . During the night the sources of short-wave radiation appear to be predominantly in the sky, the natural light of which contains a considerable amount of ultraviolet radiation. The luminescence of the night sky is the principal source of ultraviolet and general short-wave radiation during the hours of darkness (Khvostikov, [1937]). Moonlight, as reflected from a reddish surface, contains a few blue and other short-wave rays and the direct light of stars and planets plays only a small part in night illumination (~25 % with a new moon).

Consequently, when the sun is not directly visible only the light from the sky can safely orient insects to escape into space. That is why a lighted lamp attracts nocturnal insects; the more short-wave rays (ultraviolet among them) it contains, the stronger is the attraction. Such illumination is similar to natural night but is brighter.

This fact was proved directly in experiments in which nocturnal or diurnal insects were kept in a dark container with a window fitted with various colored light filters. Almost all the insects rushed to the uviol glass, which is black to us, and passes only ultraviolet light, and not to the green or yellow filters which are bright to us, even though, in terms of energy, the latter transmitted more light than the former.

Our hypothesis also elucidated other aspects of the behavior of insects toward light. For instance, insects do not fly away from a lamp because even a temporary exposure to an illuminated zone brings about an adaptation of the eyes to light. Ultraviolet rays, in the same way as other longer light rays, actively transfer the protective pigment of the ommatidia from the nocturnal position to the day position : Piament travels upwards to the dioptic apparatus of the ommatidia and seems to restric the inlet apertures (Merker [1929]). The sensitivity of light-adapted eyes drops a hundred times and they are not capable of discerning objects under a lower illumination. Because of the mechanism of adaptation a burning lamp "does not permit" insects to side-track into the obscurity of night. In addition to this, nocturnal species of insects become sluggish and lose their activity, a conditions which corresponds to the natural state when the protective eye pigment is in the diurnal position.

A lamp does not attract all nocturnal insects to an equal degree. Above all, light-loving insects living in open, strongly illuminated biotopes (steppe species, inhabitants of water and coastal areas) fly intensively . For example, aquatic insects (Dytiscidae, Corixidae) during flight often plunge in one swoop upon the shining roofs of houses or on to asphalt roads or hot-bed frames, assuming them to be water surfaces or a mirror reflecting the night sky. Other nocturnal species frequenting darker places (earwigs, cockroaches, Tenebrionidae, Tineidae) rarely fly to light.

On steppes and deserts, in contrast to wooded areas, light radiates to great distances on account of the flatness of the relief and dryness of the air. That is why the radius of the attractive action of radiation on steppes and arid areas is so high and insects fly so readily to lamps from over large areas : Hundreds of thousands of individuals are caught in traps at night (Bogush [1951]) In districts with a very humid climate, for example in Abkhaz, the advantage of mercury-vapor lamps over the usual (half-watt) lamps is less noticeable because the water vapor in the air strongly absorbs ultraviolet rays, limiting their distribution (Milyanovskii [1957]).

The mass flight of insects to light on steppes and deserts is also assisted by the fact that in more southern latitudes the night is darker than in the north. On light nights the contrast between artificial and natural illumination is visible from far smaller distances,over which the radius of the attractive action of light diminishes. Moonlight by itself does not stimulate the activity of insects (except mayflies) and, moreover, it does not depress it as some authors suppose (Williams, Singh and Ziady [1956]).

Nevertheless, our hypothesis does not pretend to explain all the reactions of insects to light. Thus, we do not touch upon the unusual features of certain groups of insects in their behavior to light,which, it appears, is due, to other causes (linked up with the various physiological states of the population, etc.). For example, winged aphids, Aleyrodidae and other insects, during the periods they are searching for food plants for their progeny, are strongly attracted to yellow light rays, and "white" light with ultraviolet has a repellent action (Moericke [1955]). Moericke supposes that at the time of migration, aphids and other insects which have completed a long flight turn upwards to the light of the sky. When the time for oviposition approaches the reaction changes :The aphids begin to fly downwards to the ground in search of food plants, reacting especially strongly to yellow and green light rays. The orientation downwards towards the earth at this period appears to be the result of a negative reaction to the light of the sun and sky.

It was observed that the ovipositing moth Heliothis zea (Boddie) does not react identically to one and the same light rays at various hours of the day: As darkness approaches the attractive reaction of green light rays decreases but that of the blue increases (Callahan, [1957]). According to the data of Dufay [1957] some moths react strongly to yellow rays in the presence of equal but high-energy illumination, but with low (equal) energy illumination the blue rays above all are attractive. In the two latter instances the stimulation to activity of moths by short-wave (blue) light rays in the evening may similarly be connected with the predominance of such rays in crepuscular and nocturnal illumination.

Thus, basically the mechanism of the flight of nocturnal insects to light rests, evidentally, on the same behaviour as is constantly effected under natural conditions. It is impossible to fit everything into our

hypothesis since its basic propositions have never received experimental proof. We suppose that the more strongly light attracts insects the nearer its spectral composition approaches that of the diffuse light of the sky. The verification of this supposition might result from a comparison of the attractive action of radiation exactly matching the spectral composition of the light of the sky (for definite periods of the day) with light of some known composition. Technically it could be obtained by matching with a corresponding luminophore. If luminophores are put onto a screen and exposed to strong ultraviolet light the screen will radiate like the night sky. In other words, it is possible to construct a luminescent lamp for insects on the same principle as modern daylight lamps are constructed.

There is a simpler technical solution : to illuminate the white cover of a lantern with such filters as transmit various light rays proportional to the distribution of energy in the spectrum of the sky. Besides this, one must realize that the distribution of energy in the spectrum of the sky is not constant : It changes considerably at various times during the day. Are such screeens extremely attractive to insects ? Further experiments will elucidate this point.

* On this is based the principle of action of automatic traps for aphids, the chief element of which appears to be a yellow adhesive surface or yellow surface covered by water.

SUMMARY

Hitherto the cause of the flight of insects to light at night has not been elucidated. Buddenbrock's (1917, 1937) popular hypothesis threw no light on the question, as insects fly not only to a radial source of light rays, for instance, a lamp, but also to diffuse light reflected from a screen.

It is very probable that light attracts insects only because it is a sign of open space, or an absence of restraints. In nature open spaces are much better illuminated than closed ones and they attract insects because there are no obstacles to avoid. Thus they can orient themselves more easily in the carrying out of one or another of their vital functions. During their life insects constantly make use of brighter illumination as an indicator of open space (exit from cavities, from dense vegetation, etc.).

Open space is characterized, above all, by an abundance of short-wave, generally ultraviolet rays. The source of these rays during the night appears to be the sky—an orienting source which leads to open space. The greater the quantity of short-wave rays (including ultraviolet rays) an artificial light contains, the more readily it attracts nocturnal insects. Such illumination is similar to, but brighter than, natural light at night.

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THE SYR-DARIA BREEDING AREA OF THE MIGRATORY LOCUST (LOCUSTA MIGRATORIA MIGRATORIA L.) AND ITS CHARACTERISTICS

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The Syr-Daria breeding area of the migratory locust (Locusta migratoria migratoria L.) is one of the main breeding areas of this pest in the USSR. It is still far from having been adequately studied, as in the last ten years we have obtained practically no new scientific data on it. Our attention was already directed to this situation in 1946 by G. Ya. Bei-Bienko, who pointed out not only the necessity for detailed studies of the characteristics of the Syr-Daria breeding area, but also the importance of generalizations from experiments for work in locust control.

In the course of the last 23 years we have had to direct , for an extended time, locust-control measures in Syr-Daria and the northern coast of the Caspian Sea, and visit infestations of the migratory locust in lower Amu-Daria, Irgiz, Eastern and Central China and other places of habitation of this pest.

During this period data were gathered which permitted us to obtain somewhat broader and more precise ideas about the specific interrelationships between the locusts and their medium of habitation, and in relation to this, to touch upon the practical aspects of locust-control measures.

In this paper we are concerned only with some questions on locust problems, for example the Syr-Daria breeding area, situated in the center of this species' range, and distinguished from other breeding areas by a series of specific characteristics. The lowlands of the Syr-Daria River have been known for a long time as a place of permanent habitation for the migratory locust.

In the northeastern part of the Kzyl-Orda region of Kazakhstan SSR, namely in the area of the terminal discharge of the waters of the Sary-Su River , there develops periodically another center of infestation of the pest, at present unrelated to the expansion of flooding in the Syr-Daria delta, though previously it was related to it. All these basic centers are expeditiously incorporated under the common designation of Syr-Daria breeding area.

On the basis of data of historians and travellers of the past, N. Dingel'shtedt [1893], L. S. Berg [1908], S. S. Neustruev [1911], and others, and also recent investigations of I. P. Gerasimov [1937], B. A. Fedorovich [1952], N. F. Fedin [1952] and V. M. Borovskii [1958], the formation of the landscape of the Syr-Daria breeding area may be separated into three periods, corresponding to the main changes in the water system in the delta of this river.

The first and most ancient period coincides in time with the conclusion of the so-called kel'teminarskoi epoch (according to the terminology of V. M. Borovskii), characterized by the discharge of the waters of the Chu and Sary-Su rivers into the Syr-Daria delta. This was a period of maximal flooding of the delta and, as may be supposed, maximal expansion of reed overgrowth.

The second period, corresponding to one of the last stages in the formation of the yaksartskoi delta (according to the terminology of the same author), was the period of the appearance of a declivity from Syr-Daria to the lowlands of the Sary-Su and the Chu, tightening the girth of these rivers and ultimately gradually forcing them into their present situation (Borovskii and Pogrebinskii [1958]). The reed zone naturally diminished during this period. However, it may be hypothetically assumed that during that time the branches of the Syr-Daria , the Dzhana-Daria and Kuvan-Daria , stretching to the coast of the Aral Sea were still active.

The third period was the one of the drying of the delta channels and a further reducing of the reed zone in the breeding area. Opinions contained in the literature are extremely conflicting as to the time of this period. Thus, Berg [1908] reports that in 1820 the Dzhana-Daria was still a functioning waterway. Fedorovich [1952] considers that flooding of the Dzhana-Daria terminated 150 years previously. Dingel'shted [1893] assets that this channel, more than 130 years previously and close to 200 years from the present time, was blocked by a large dam during the occupation of Ak-Mechet (at present Kzyl-Orda) by the Caucasians and the water in it dried up and the valley of this channel "became a desolate waste". Borovskii [1958], on the basis of studies of the head portion of the dried-up waterway of the Dzhana-Daria, comes to the conclusion that its connection with the Syr-Daria existed at a remote time and that after the drying of this channel, water got into it only from large floods at the head portion. He marks 1907 as one of the last expansions in the flooding of the delta. At this time the floods supplying the Dzhana-Daria dried up completely. The

Duvan-Daria still existed at that time, but it had already lost the connection with the Syr-Daria channel and was supplied with water from expanded lakes and ponds existing in areas between Kzyl-Orda and Dzhusal Station, which at the present time have likewise dried up.

At the end of that period, i.e. 50-70 years ago, among the once continuous lakes and streams, there appeared the Kara-Uzyak channel and the Kok-Su lake system. This stage in the formation of the breeding area is related to its present condition.

At the present time, in the zone of the Syr-Daria breeding area, there is reckoned to be one million hectares of reed overgrowth. This overgrowth is a permanent place of habitation for the migratory locust, and for this reason we consider it as the locust's characteristic site.

Under the influence of the hydrologic regime of the Syr-Daria River and the terminal discharge of the Sary-Su River, creating various degrees of moisture, several types of situations combined here, determining important peculiarities in the behavior of the migratory locust and having substantial effect on many aspects of conducting the entire complex of locust-control measures. With an assessment of the degree of significance of a given factor, three basic types of sites should be separated here : dry, flooded and swampy.

Dry sites represent relatively elevated breeding places. They are distributed in wide bands along the margins of desolate zones, on raised banks of numerous water systems, separate reservoirs, and on slopes of islands. These sites are either not submerged by flood waters or else they are only partially submerged and not for an extended time. They comprise a vast part of the breeding area, equal to an area of about 600-700 thousand hectares. Reeds are often suppressed here, stand density (number of stems per unit of area) and height being lowest in comparison with other types of sites. The approximate density of reed stands in dry sites may be taken as 20-60 stems per 1 M^2, height of the vegetation ranges from 0.5 to 2 m^2; Only in some places, along raised banks of rivers, river branches and channels, where there is constant moisture due to rising waters, stand density of the reeds attains about 80-100 stems per m^2; and their height is from 5-6 m.

Flooded sites have an overgrowth of reeds where they are submerged in water permanently or for the greater part of the year. Territorially they occupy the most depressed riparian portions of lakes, rivers, river branches and channels. They are generally distributed in breeding areas, more often in the form of narrow closed strips arranged in the riparian portions of shallow ponds. In regard to area of reeds this type of site consists of not more than 50 thousand hectares in years of drought and up to 100 thousand hectares in heavy flood years. Height of reed vegetation is from 3-4 m, and stand density is up to 60-70 stems per 1 m^2.

Swampy sites territorially occupy an intermediate position between dry and flooded sites, characterized by abundant moisture, but covered by water for a less extended period than the flooded sites, most often only during the period of spring (April-May) and summer (July-August) floods. This hilly (peat bog) swampy situation, as a rule is densely overgrown with reeds, attaining in places a height up to 5-7 m. They occupy areas of about 250-350 thousand hectares. The density of the reed stands is highest -- up to 200-250 stems per m^2.

For a graphic display of the characteristics of the above, we present a scheme of the distribution of reed overgrowth according to site type (Fig. 1).

It should be noted that the relationships between types of sites are not permanent and that they change in relation with flood levels: Dry sites may partially become desolate areas if drought occurs for 3-4 successive years in the breeding areas, or become swampy sites if they have flood years instead; under the influence of the same factor, flooded sites become swampy sites and, conversely, swampy sites become flooded sites.

Redistribution of sites is quite a widespread occurrence in the breeding area. Thus for the past 10 years, under the influence of acute fluctuations in flooding, the entire reed zone of the breeding area has altered, as well as the distribution of the above-mentioned sites within it. After the heavy flooding in 1949 there followed drought in 1950 and 1951, following which in 1952 even such large water systems as the Kara-Uzyak, Kok-Su and others were significantly reduced. Here, as in other places, there occurred a significant decrease in the reed zone and a

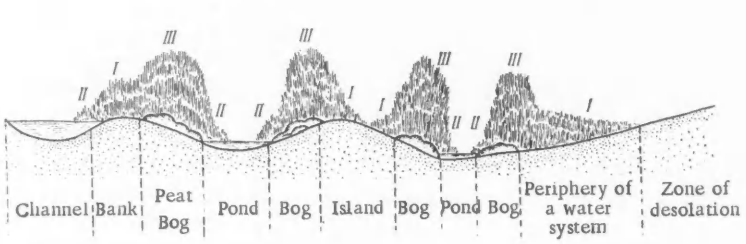

Fig. 1. Scheme of distribution of the basic types of sites for the migratory locust in the Syr-Daria breeding area. Sites: I) dry sites, II) flooded, III) swampy.

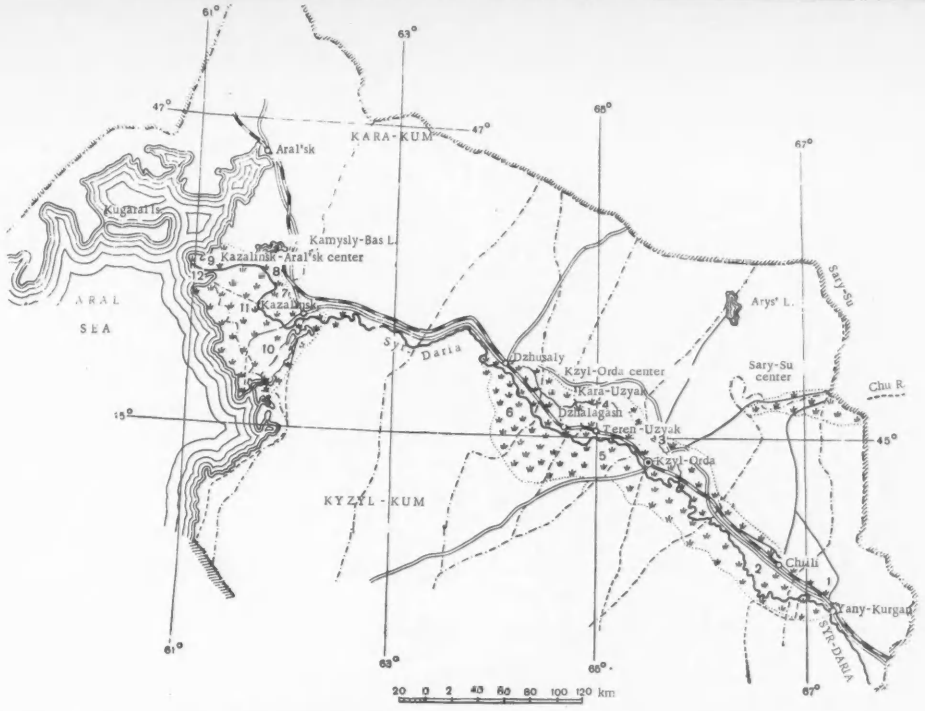

Fig. 2. Schematic map of the centers of the Syr-Daria migratory locust breeding area. Approximate centers of the main water systems are designated by figures: 1) Sunakatinsk-Taipak; 2) Chuli-Bulkuldak; 3) Kok-Su; 4) Kara-Uzyak; 5) Chirkiilinsk; 6) Ayu-Zharminsk; 7) Chulak-Aryk; 8) Raimsk-Karibugut; 9) Chushka- Aral'sk;10) Ak-Sais; 11) Berkazan-Karakul; 12) Kara-Teren.

redistribution in the site types. Heavy floods of 1952-1954 not only restored the previous condition of the sites, but significantly expanded the reed zone due to the flooding and overgrowth of desolate places with reeds. The average precipitation in 1956 and the unprecendented drought in 1957 again determined significant changes among flooded and swampy sites, but because of the intensive saturation with moisture during the previous years there was not a noticeable reduction of the reed zone. Here and there the drifting process of reed mortality among dry sites was curtailed by the heavy flooding in 1958.

In years of heavy drought in the breeding area,more than half of the flooded sites disappear, becoming swampy sites;the latter, with a significant loss of moisture, turn into dry sites and their area is reduced by half or more. During such periods, reed mortality may occur in dry sites, especially in places adjacent to the desolate zone. Following this the total area of the reed zone in the breeding area may vary by 100 thousand hectares and even more, i.e., it fluctuates in the range of 900-1200 thousand hectares.

A more acute change in sites occurs in the Sary-Su center, under the influence of the hydrologic regime, on the specific descriptions of which we shall dwell upon below, with the characteristics of the center.

Our long-term observations disclosed that dry sites are favorite places of oviposition and development of the first two nymphal instars in the migratory locust. In addition, during the period of settlement of locust for oviposition, there often occurs an increase in their density in these sites; for this reason there may occur, on this site type, the appearance of the gregarious form of the pest (ph. gregaria) from the solitary form (ph. solitaria).

Swampy and flooded sites, the access to which is difficult, have been studied less. They are the main food resources for the locusts and serve as places for the development of the later instar numphs and of the imaginal stage up to their dispersal for oviposition. Flooded sites, naturally, cannot be places for oviposition; swampy sites become infested with egg sacs only partially during years of mass increase of the pest.

The type of site determines, to a certain extent, the character of the daily migration of nymphs and the density of the pest per unit of area. In dry sites the daily migration of nymphs occurs with greater speed than in the other two site types. In swampy and flooded sites later instar nymphs accumulate in larger masses, not infrequently bending to the ground with their weight reeds 4-5 meters in height.

Upon the whole, changes in the relationships between site types, and their frequent redistribution characterize the high degree of variability among the locusts' habitations. This circumstance has significance not only for understanding the locusts' dynamics, but also characterizes the specific difficulties in the organization of locust control measures. Greater variety and variegation in the territorial alternation of all three types of sites in any place of the locusts' habitation is related to a greater persistence for increase.

The accuracy of this conclusion is confirmed by the data presented below on the details of individual centers in the Syr-Daria breeding area.

Under recent conditions we separate, within the boundary of the Kzyl-Orda Region, three centers of the migratory locust : 1) Kazalinsk-Aval'sk, 2) Kzyl-Orda, and 3) Sary-Su (Fig. 2).

In regard to size of territory, the Kzyl-Orda center stands in first place, occupying the flooded portions of six administrative districts of the eight in the region; in second place, the Kazalinsk-Aval'sk encompassing the mouth of the Syr-Daria River and a large part of the east coast of the Aral Sea, and in the third place, the Sary-Su. The latter, located in the north of the Syr-Daria Region, gravitates almost in the same degree towards the centers of the Chu River lowlands.

Moreover, along the east coast of the Aral Sea there is located a narrow reed zone, superficially appearing suitable for habitation by the migratory locust. Here, along the shores of the sea within the boundaries of the Kzyl-Orda Region (approximately from Kug-Aval'sk Island in the north and to the border of Kara-Kalpak ASSR in the south), reed overgrowth is located in small patches with a total area of about 13 thousand hectares; of these about 4 thousand hectares are found in shallow littoral waters, and the rest on dry land. Instances of mass increase in locusts have not been noted here, and there is hardly any basis for considering these places to be self-contained centers. However, it is possible to have an influx of gregarious locusts here and the formation of a temporary center during the mass-flight period of the pest.

Location of the centers and their separate plots, and their character traits combine, as do the site types, under the influence of the peculiarities of the aquatic regime.

In the zone of the centers we reckon there are no less than 248 temporary and permanent lakes with an area of water surface more than 45 thousand hectares; no less than 10 large, natural, permanently functioning channels and river branches; 16 main irrigation ditches with a total length of 600-650 kilometers; more than 450 outlets from the main irrigation ditches with a total length about 4-4.5 thousand kilometers; and also tens of small and large washed-out hollows appearing during the high water level in the Syr-Daria. All of these naturally and artificially created reservoirs and water ducts have no reliable regulatory accomodations; according to the data of the former Kzyl-Orda Scientific Investigation Base of the Academy of Sciences Kaz. SSR, of the significant portion of the discharge waters (up to 53 %) entering the lowlands of the Syr-Daria, only 7% is used up. A large part of the discharge (46 %) runs into the Aral Sea, but a portion flows along numerous branches and channels, forming a whole series of minor water system developments.

In the Kzyl-Orda center there is located a series of water systems. Along the right bank of the Syr-Daria River these are (counting downstream: Sunakatin-Taipak, Chiili-Bulkuldak (Yany-Kurgansk and Chiili administrative regions), Kok-Su (Syr-Daria, Teren-Uzyak Regions), Kara-Yzyak (Teren-Uzyak, Dzhalagash, Karmakchinsk Regions). Along the left bank of the Syr-Daria there are located two main systems: the Chirkiili, which at present is dried up, due to the fact that the discharge of the waters along the Chirkiili canal became regulated by a dam built near the city of Kzyl-Orda, and the Ayu-Zharmin (Dzhalagash and Karmalchinsk Regions).

Each of these water systems represents a series of small channels, washouts and overflows of artificial or natural canals and irrigation ditches, with a great number of islands and swampy places, which as a whole causes a significant diversity of site types in a center and a high persistence in locust increase, especially in its more flooded parts.

On the right bank of the Kzyl-Orda center there are reckoned to be almost 470 thousand hectares overgrown with reeds, of which 300 thousand hectares are suitable for oviposition by locusts. They are characterized by the lowest level in density and height of reed growth, with only partial temporary submergence by flood waters, and about 170 thousand hectares of flooded and swampy sites, which are not suitable for oviposition. On the left bank there are 250 thousand hectares of reeds, among which 190 thousand are suitable and 60 thousand hectares unsuitable for oviposition. Consequently, in the entire Kzyl-Orda center there is reckoned to be 720 thousand hectares overgrown with reeds, of which 490 thousand occupy dry sites suitable for oviposition by the pest.

The southeastern part of the Kzyl-Orda center within the boundaries of the Chiili and Yany-Kurgansk regions is less flooded. The irrigation system here is better managed, and for this reason minor overflows which increase acutely the flooding of sites of locust habitation and the variegation in their type patterns, are less pronounced in these places. As a result, in this part of the center mass outbreaks of the migratory locust occur less frequently and are not as protracted as in the remaining parts of the center.

The Kazalinsk-Aral'sk center likewise consists of a series of water systems on the right and left banks. On the right bank are located the Chulak-Aryk, Raimsk-Karibugut and Chushka-Aral'sk water systems (Aral'sk

District), and on the left bank the Ak-Sai, Berkazan-Karakul and Kara-Teren'water systems (Kazalinsk and Aral'sk Districts). Here there are reckoned to be 230 thousand hectares overgrown with reeds, of which 150 thousand hectares are suitable for oviposition; in addition, 90 thousand hectares are located on the right bank, of which number 65 thousand hectares are suitable for oviposition, while on the left bank there are 140 thousand hectares, of which 85 thousand hectares are suitable for oviposition.

On the whole, the center is heavily flooded and very swampy. A heavy persistence in locust increase is characteristic of it, just as the fact that this increase is observed in the moist flooded part of the Kzyl-Orda center.

The Sary-Su center, located 90-100 kilometers northeast of the city of Kzyl-Orda and formed by the action of the terminal discharge of the Sary -Su River, is subjected to a more acute fluctuation. This is explained by the fact that the discharge of waters from the Sary-Su is very inconstant, and periodically the water does not penetrate here at all. Thus, three times during the last 15 years, namely in 1947, 1952, and 1956, it dried up almost completely, but afterward it again abounded in water. During the flood period in this center all the basins are immersed in water, as a result of which there emerge no less than ten long-lived lakes and about twice that number of temporary ponds, i.e. all three types of sites are formed. The reed zone along the overflow expands up to about 30-40 kilometers in length and from 3 to 10 kilometers in breadth, forming an overgrowth with a total area of 27 thousand hectares. However, of this area during flood years, the area suitable for oviposition consists only of up to 17 thousand hectares, the remainder being unsuitable for deposition of egg sacs. The most characteristic and vast site suitable for oviposition by the migratory locust occurs in the western portion of the center.

Owing to the periodic occurrance of acute changes in ecological conditions, in part the redistribution of site types, the Sary-Su center by its nature is a temporary, unstable center. However, at the present time, in order to improve the available summer pasture here, work is being conducted on the artificial flooding of this region, and it should be assumed that the reed zone here shall soon become persistent and the territorial alternation in site types more varied, which should create better conditions for the locusts and increase the significance of the center in the total balance of the pest. The regional agricultural organizations and plant protection organizations should have this situation in view.

Other ecological factors in the migratory locust centers, such as peculiarities in the temperature regime, atmospheric humidity and others, appear to be more constant indicators of the medium, and upon the whole are favorable for the development of the pest here.

An analysis of the history of increase and control of the migratory locust in the Syr-Daria breeding area conclusively affirms that in the overwhelming majority of places it invariably finds the conditions necessary for high productivity in its progeny and high survival of its populations. Thus, in the last 19 years (from 1940 to 1958) altogether more than 1,152,000 hectares of land infested with locusts was cultivated in the breeding area; of this close to 1,050,000 hectares under cultivation belong to the Kazalinsk-Aral'sk center and the more flooded part of the Kzyl-Orda center, together consisting of 850 thousand hectares of breeding site, and only a little more than 100 thousand hectares under cultivation belonging to the entire remaining part of the breeding area, consisting of 130 thousand hectates of site. Control action has been taken against this pest annually in the Kazalinsk-Aral'sk center and in the more flooded Kzyl-Orda center, but nevertheless outbreaks of the gregarious form of the locust still recur here.

The heaviest locust outbreaks in the last quarter-century occurred in 1935, 1940 and from 1945 to 1951 and, very characteristically, each time after a decrease of control over the breeding area and reduction of work volume in exterminating the pest.

So the high stability of both Syr-Daria centers (excluding the fewer flooded parts of the Kzyl-Orda center) is fully dependent on the variegation of the sites of locust habitation in relation to the variability of the aquatic regime, but it does not however exceed, upon the whole, the limits of the requirement norm for the species.

The question of the role of the aquatic regime frequently appears as a topic for discussion in foreign literature as well as in ours; however in our opinion the final solution has still not been found.

Some investigators (Olsuf'ev[1930], and others), correctly pointing out the great significance of the aquatic regime in the life of the locust, were inclined to regard it as a basic factor regulating the periodism of mass outbreaks of the pest, with which we cannot agree.

Under conditions of the Syr-Daria breeding area, where summer floods (in July) submerge all depressed places in dry sites suitable for oviposition , and where the recession of waters is most often completed when the locusts are already dispersed for oviposition, their egg sacs are found deposited in a mass outside the zone of innundation, i. e. on more elevated places and not on lake bottoms as stated by V. V. Nikol'skii [1925]. V. Ya. Novitskii [1953] likewise noted that in the Amu-Daria breeding area, very similar to the Syr-Daria breeding area according to ecological indicators, the migratory locusts more often deposit egg sacs on high and dry, well-warmed places with sparse vegetation.

Numerous soil excavations in the Syr-Daria breeding area always provided the opportunity to observe that banks of numerous irrigation ditches, canals, lakes and

Areas of Infestation and Inundation of Egg Sac Deposits and Treatment in Years of Greatest Precipitation in the Syr-Daria Breeding Area (excluding the Sary-Su center)

Area No.	Years	Infested with egg sacs (hectares)	Submerged in spring until hatch of locusts		Actually treated by all methods (hectares)	Remarks
			hectares	%		
1	1945	43383	21569	50	36025	For the lack of poison a large infested area remained untreated.
2	1948	99890	23279	23	160248	
3	1951	12730	9356	73	14127	

other places with positive elements of relief are the most densely infested with egg sacs. Owing to the deposition of eggs mainly along elevated places that are submerged briefly in the spring , the massive egg mortality that occurs on the ground of the entire breeding area is not observed here.

To support this we present a table.

It is obvious from the data presented that even in years of massive flooding of egg sacs in the period of the spring run-off, no significant decrease in pest stock occurred whatsoever, as a result of any egg sac mortality, although after all these years of treatment during the locust control, the area did attain a significant size. Direct observations conducted in different years, among them years of greatest flooding, likewise did not disclose any mass mortality of egg sacs. For example, in the spring of 1948, when the flooding of egg sacs attained 23 % of their area, egg sac mortality, following the recession of the water, did not exceed 5-10 %.

The facts presented attest sufficiently to the conclusion that the present character of the aquatic regime in the Syr-Daria breeding area cannot by itself prevent outbreaks of mass increase of the pest and determine its occurrence. On the contrary, frequently repeated flooding of places of locust habitation complicates their development to an extreme, hampers significantly the application of the entire complex of locust control measures, and lowers their total effectiveness, which may only bolster the growth of the pest's numbers.

Moreover, in some drought years during the onset of reed mortality, locusts from separate plots may move to places more moist, with a better plant cover, where there can thus occur an increase in their density and an improvement in conditions for their future increases; here the concentration of solitary locusts creates concrete conditions for their change into the aggressive gregarious form (Bei-Bienko [1951]; Uvarov [1957]). This change in locust habitation in drought years, but its ecological nature, represents events related to the principle of site change of G. Ya. Bei-Bienko [1930, 1959].

An exception to all of the above is represented by the Syr-Daria center, which at present does not have a connection with the Syr-Daria basin. During the period of its drying , increase of locust ceases here, evidently owing to egg mortality due to insufficient contact moisture.

In this way the hydrologic regime may not be an equally influential factor in all centers of the Syr-Daria breeding area; even in its separate zones their own concrete conditions and variations may combine in the specificity of the locust's dynamics.

We arrived at a similar conclusion also, in comparison of data on the role of the aquatic regime of the Syr-Daria breeding area with breeding areas in other parts of the locust's range, among them Eastern China (Tsyplenkov, [1959]).

During our stay in centers of the migratory locust in Northeastern China (Burchumsk center on Chernoi Irtysh, Bagrach-Kul'skin Kashgar and others, 1950, 1955-1956) and in centers of the eastern migratory locust (Locusta migratoria manilensis Mey .). in Central China (1955-1956), we noticed that in each of these centers the aquatic regime affects the locusts differently.

In the Burchumsk center (mean annual air temperature 5°C) the period of flooding usually lasts a long time, from May through July inclusively. Thus, as the location of this center is comparitively northerly, development of locusts here proceeds slower and the flooding corresponds to a large extent with the period of the pest's embryological development. In this connection, mass increases of locusts occur rarely here.

In the Bagrach-Kul'sk center (mean annual temperature 10.6°) the periods of flooding are similar to the preceding; however, owing to a more southerly location of the center, the locusts here hatch before flooding of egg sac deposits occurs, and they survive well.

In centers of the eastern migratory locust in Central China, under the influence of a relatively higher air temperature (mean annual temperature for Baodin in northern centers 12.2°), the intensive embryological development often corresponds with the period of flooding of egg sacs, not infrequently causing significant and sometimes complete mortality of eggs. As affirmed by Ma Shih-chüan[1958], in 15 days after flooding.55-60 %

of the eggs die here, after 30 days 88 %, and after 45 days, their complete mortality is already noted.

In the Syr-Daria breeding area of the migratory locust, where the combination of the temperature and aquatic regimes have little in common with the conditions of migratory locust habitations in the aforementioned centers of Sinkiang or Central China, the aquatic regime has its own concrete specific effect on the locust. While influencing the development and dynamics of the pest complexly and diversely, the aquatic regime may only accelerate or sometimes retard the process of transformation of the solitary form of the locust into the gregarious form, but under present conditions the mass increase of the pests on the grounds of the entire breeding area may not be stopped, as is indicated in part by the data in our table.

Under these conditions the undesirable process of numerical growth of the locust may be prevented only by the active destruction of the pest. This situation shall persist until the onset of a period of thorough displacement of the locust in the breeding area. This period shall arrive not as a result of the application of particular chemical means of control, but on the basis of the transformation of local natural conditions in the direction of acute deterioration in conditions necessary for the species' existence.

The solution of the problem of complete displacement of the migratory locust in the Syr-Daria breeding area is completely tied in with the regulation of the hydrologic regime. For the complete destruction of the pest here it would be necessary to drain completely all of the numerous lakes, swamps and ponds in the Syr-Daria River delta, reconstruct the irrigation system, create a hydroconstruction engineering model, and on this basis organize economically not less than 1-1,5 million hectares.

We visualize that sooner or later we shall inevitably arrive at the realization of designing a scheme for regulating the aquatic regime, and the economic utilization of the most productive land in the breeding zone. This will be accomplished by the gradual economically expedient organization and utilization of local resources with the contribution of sound effort. Until this is accomplished the Syr-Daria lowlands shall remain functioning continually as an active breeding area for the migratory locust.

In accordance with the above, at the present time the basic problem in the control of locusts is the inhibition of their mass increases and suppression of growth in their numbers by means of careful inspections of their breeding area and of the solitary form of locusts, and by a more active institution of the entire complex of locust extermination measures (Tsukerman [1959]).

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ON THE NESTING HABITS AND POLYTROPISM OF HALTICUS MACULATUS SM. (HYMENOPTERA: HALICTIDAE)

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The genus Halticus as understood in a broad sense, is one of the largest genera of hymenoptera generally, and is the largest among the lower hymenoptera. At the present time it contains more than 2000 described species. Their biology is complex and varied, and has been studied only in a very few species. Nevertheless, the evolution in mode of nesting from the typical solitary to a communal type is clearly evident.

The genus Halticus is a heterogeneous genus. Further systematic studies undoubtedly shall arrive at its division into smaller natural genera, attempts at which have already been made repeatedly, but without particular success. In connection with this, studies of biology and nesting in the species of Halticus may not only have a certain theoretical significance as material for the evolution of hymenoptera, but may also be significant as secondary material for the construction of their natural organization.

At the same time the biology and nesting of solitary hymenoptera represent a great practical interest, inasmuch as many wild hymenoptera are important as pollinators of various agricultural plants. Among them, and occupying a place not far behind them as pollinators, are very abundant numbers of preeminently polytrophic species of the universally distributed genus Halticus. For the expeditious utilization of wild bees it is necessary to know the peculiarities of their nesting. Even though the number of investigations of nesting in hymenoptera is steadily increasing, studies of their nesting are still far from sufficient, and for many genera of hymenoptera nesting is generally unknown.

Among the paleoarctic species of the genus Halticus, nesting has been studied in few species. It was first studied by E. Eversmann in H. quadricinctus F. (Eversmann [1846]). Later Verhoeff (Verhoeff [1891, 1897]), Stöckhert (E. Stöckhert [1923]) and Friese (Friese [1932]) presented detailed observations of the biology and nesting of H. maculatus Sm.

Stöckhert (E. Stöckhert [1923]) states that the species of Halticus are distinguished by the degree of development in them of communal living. H. malachurus K. is always a communal species, as it has workers that are morphologically distinguishable from ordinary females. Communal living is not as acutely developed in H. immarginatus Schenck., H. scabiosae Rossi, H. maculatus Sm. and H. calceatus Scop. According to the data of Meidell [1958] for H. calceatus Scop. and H. leucopus K. and Quênu [1957] for H. marginatus Brullé, only rudiments of communal living are encountered in these species, without accompanying morphological changes. Finally, the remaining paleoarctic species of Halticus, whose nesting was investigated, lead a solitary mode of life.

Investigations of nesting in H. maculatus Sm. were conducted in the summer of 1958 in the village of Borisovka, Belgorod Region, lying in the central chernozem belt of the European part of the USSR. It was in this locality, namely, that S. I. Malyshev studied in detail the nesting of many species of solitary hymenoptera, and the results of the studies were later summarized by him (Malyshev [1936]); it was here that the methods for this study were worked out (Malyshev [1931]).

According to Stöckhert (E. Stöckhert [1923]) the summer females in H. maculatus Sm. live in the same nest with the spring females, when the general number of females most often attains six. There is no information on the nesting of H. asperulus Per., a species close to H. maculatus Sm.

Fig. 1. A general view of a slope on which Halticus maculatus Sm. nests.

Fig. 2. A canal on the east edge of a wood – a nesting place of Halticus maculatus Sm.

Two nests of H. maculatus Sm. were investigated. One of them was found in the upper portion of a sloped incline (Fig. 1). The other was located on a steep bank of a canal (Fig. 2) 1.2-1.5 meters deep, and arranged on the east edge of a wood. Here nest H. calceatus Scop., H. moria F. , Rophites canus Ev., Osmia aenea L., and Anthophora pubescens F. In the course of summer various herbaceous plants sprang up on the slope (in order of abundance) : grasses, Hieracium pilosella L., Plantago lanceolata L., P. media L., Potentilla argentea, L., Medicago falcata L., Artemisia austriaca L., Gypsophila muralis L., Berteroa incana D. C. , Achillea millefolium L., A. setacea L. Lotus corniculatus L., Trifolium arvense L., T. repens L. , Melilotus officinalis Desr., Picris hieracioides L., Carduus crispus L., Sedum acre L., Ranunculus polyanthemus L., Euphorbia sp., Hypericum perforatum L., Digitaria sp. Generally, 70-80 % of the soil on the slope was covered. The herbaceous cover was significantly thinner near the top of the slope. The canal band was generally almost devoid of vegetation; here were encountered single Digitaria sp. and Plantago lanceolata L.

The entrance hole of the nest was discovered July 27 at the top of the slope, located in the center of a small mound of dug soil 6 cm in diameter (Fig. 3). Diameter of the entrance hole was 3 mm. From the entrance hole there began a vertical passage with small angular curvatures, and extended to a depth of 6.7 cm. Farther on, the passage again extended vertically. Total length of the passage was 16 cm. The nest contained two empty cells and one with an early instar larva. The other nest was far more complexly arranged, so that it is necessary to dwell upon its structure in more detail.

Fig. 3. Mound around the entrance hole of the nest of Halticus maculatus Sm.

The other nest was found at the beginning of August in a steep canal bank. At that time the females were gathering pollen. Frequently several females could be seen, with yellow-grained pollen sacs, flying simultaneously to the entrance hole of the nest. One of them would immediately enter the nest, and the rest, detained for several seconds at the entrance to the nest, afterwards would also enter it. At the time the nest was excavated six building females were found in it. The entrance hole of the nest was 3 mm in diameter and located on the surface of the vertical incline of ground and was without a mound. Beginning from the entrance hole, the main passage, 5 mm, in diameter, deepened to 7.5 cm under an angle (Fig. 4) after which it branched into seven passages of the same diameter lying in different planes. Length of passage I– 10 cm, II– 23.5 cm, III–27.5 cm, IV– 23 cm, V –18.5 cm, VI– 17 cm, VII–31.5 cm; passages III and VII were always tortuous, the rest were straight. Cells adjoined the passages of the nest from all sides. Their total number in the nest at the time of excavation equalled 42. A large proportion of the cells were found in passage II, where their main mass was concentrated in its upper part. Of the total number of cells 11 were empty, in 7 there were found bees (4 females, 3 males), in 7 pupae, in 9 larvae, in 2 eggs, and in 4 there was a reserve of bee bread; 2 cells apparently were infested with parasites. A proportion of the cells were oriented almost vertically to the soil surface, and others were less inclined. On August 6 the constructions of the nest was apparently still not completed. The sections of passages with a steep incline, designated in Fig. 4 with the letter f, may be regarded as the beginnings of new passages. The walls of the passages had no special lining; they were only slightly smoothed. The walls of the cells were more elaborately polished and were slightly shiny. The cells were oval in shape, 10-11 mm long; their diameter was 6 mm at the broadest part, and 2.5 mm at the narrowest part. The provision in the cell was cons-

Family	Species	Number of bees
Ranunculaceae	Ranunculus polyanthemus L.	60 ♀ (60 п) *
	R. repens L.	1 ♀ (1 п)
Cruciferae	Capsella bursa pastoris L.	5 ♀ (5 п)
	Berteroa incana DC.	2 ♀ (2 п)
	Sisymbrium loeselii L.	1 ♀ (1 п)
	Thlaspi arvense L.	1 ♀ (1 п)
Cucurbitaceae	Cucurbita pepo L.	1 ♀ (1 п)
Rosaceae	Potentilla argentea L.	4 ♀ (4 п)
	Fragaria vesca L.	4 ♀ (4 п)
	Rosa cinnamomea L.	2 ♀ (2 п)
Leguminosae	Melilotus officinalis Desr.	2 ♀ (2 п) 2 ♂
	Medicago sativa L.	1 ♀ (1 п) 2 ♂
	M. lupulina L.	2 ♂
	Lotus corniculatus L.	1 ♂
	Trifolium pratense L.	1 ♀ (1 п)
Umbelliferae	Aegopodium podagraria L.	1 ♀ (1 п)
Labiatae	Mentha silvestris L.	1 ♀ (1 п)
Caprifoliaceae	Lonicera tatarica L.	1 ♀ (1 п)
Compositae	Taraxacum officinale Wigg.	12 ♀ (12 п)
	Hieracium pilosella L.	12 ♀ (12 п)
	H. umbellatum L.	3 ♀ (3 п)
	Carduus crispus L.	12 ♀ (12 п) 1 ♂
	Cichorium intybus L.	3 ♀ (3 п)
	Inula britannica L.	1 ♂
	Leucanthemum vulgare Lam.	1 ♀ (1 п)
	Stenactis annuus Ness.	3 ♀ (3 п)
	Picris hieracioides L.	1 ♂
	Centaurea arenaria MB.	1 ♀ (1 п)
	C. scabiosa L.	2 ♀ (2 п)
	Crepis tectorum L.	1 ♀ (1 п)
	Onopordon acanthium L.	3 ♀ (3 п)
Plantaginaceae	Plantago media L.	1 ♀ (1 п)
Campanulaceae	Campanula rapunculoides L.	1 ♀ (1 п)
Scrophulariaceae	Veronica chamaedrys L.	22 ♀ (22 п)
	V. prostrata L.	3 ♀ (3 п)
		168 ♀, 10 ♂

*п= females with pollen.

tructed in the form of a spherical loaf 3.5mm in diameter, and was very viscous and fairly compact.

Following the investigations of Verhoeff (Verhoeff [1891]) the opinion was established that the nesting of H. maculatus Sm. represents the simplest type among hymenoptera. However, as is evident from the construction of the nest found in Borisovka, H. maculatus Sm. builds a complex nest consisting of a large number of cells and for this reason it can hardly be regarded as very simple. The nest discovered on August 6 consists essentially of seven separate nests.

The life cycle of H. maculatus Sm. is very complex. The question as to the number of generations is still unresolved. Studies of the life cycle were conducted by Stöckhert [1923] and Noll [1931]. Stöckhert considers that two generations develop in H. maculatus Sm. One of the them winters through, and these females build the nest in spring. The first generation appears in June, and the second in August. Females of both generations are encountered in September, after which the summer females apparently die, and the autumnal females during winter.

According to the material obtained in Borisovka, it may be assumed that two generations exist in H. maculatus Sm. In spring the winter females begin to built a nest, consisting of the main passage and passage I; several cells branch out from passage I. The summer females, emerging from the cells of passage I (at the time of excavation they were all empty), construct the remaining passages (II -VII). In the nest there were found 4 females, 3 males, 7 pupae, 9 larvae and 2 eggs belonging to the second generation.

During excavation one female of the parasitic wasp Sphecodes subovalis Scheck was discovered at the end

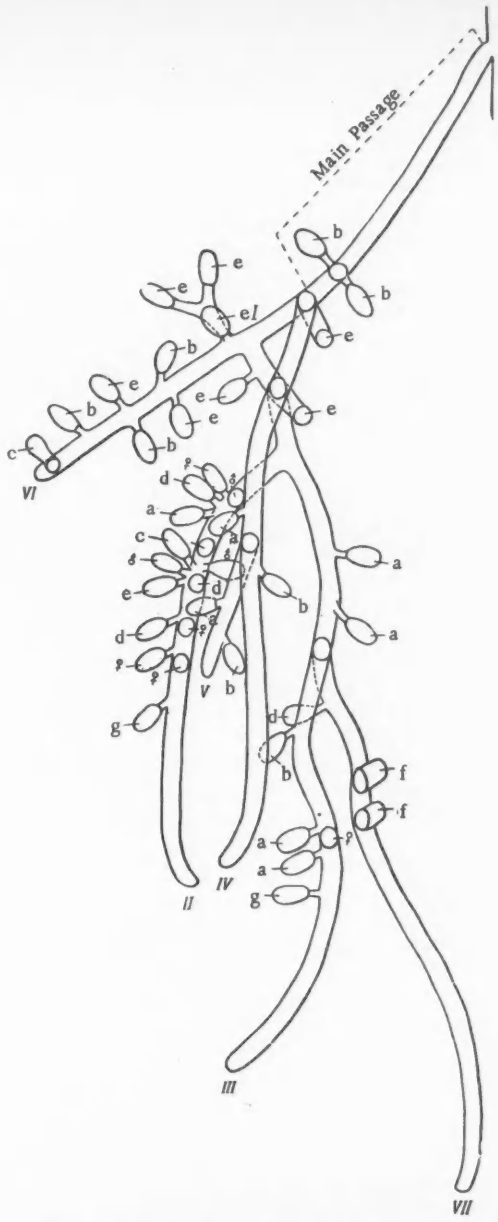

Fig. 4. Scheme of the nest of Halticus maculatus Sm. a) Pupa; b) larva; c) egg; d) bread; e) empty cell; f) beginning of a passage; g) parasitized cell. Roman numerals — passages.

of passage VII. According to F. Stöckhert [1933], H. maculatus Sm. is parasitized by Sph. subovalis, as well as by Sph. divisus K.

According to collections from flowering plants in 1957-1958, this species was encountered in Borisovka from May 28 to August 25. Twenty-five females were collected at the end of May. These were probably winter females. Ten females were caught in June, representing the first generation. The second generation appeared in the beginning of August (14 females, 7 males). The flight period of males apparently is very short. Males of the first generation were neither found in nests nor at large.

Males of the second generation were collected only in August in nests and on flowers. At the end of July and in August they were noted also in the Kaliningrad Region (Alfken [1912]).

The distribution of this species on flowering vegetation was studied for Germany (F. Stöckhert [1933]; Rapp [1938]), right-bank steppes of the Ukraine (Osychnyuk [1955]) and the Kiev Region (Lebedev [1933]). The species is recorded on 51 species of plants, belonging to 16 families, of which 26 species are composites, 6 rosaceas, 4 rananculas, 3 legumes, and 2 crucifers, labiates, mallows, milkworts, and 1 figwort, willow, maple, mignonette, campanula, pink, umbellifer, and poppy. In Borisovka the species has been noted on 35 species of flowering plants (see Table).

The material presented permits the conclusion that H. maculatus Sm. is an extensively polytropic species. A definite preference is observed for flowers of the Compositae, Rosaceae, Ranunculaceae and Leguminosae.

H. maculatus Sm. is widely distributed in the Paleoarctic Region. Its range includes almost all of Europe and Asia Minor and it has also been recorded in Central Asia and in the East to the South Kazakhstan Region. It is very probable that its actual limits pass significantly more eastward.

The related species H. asperulus Pèr. (H. rugulosa Pèr.), is known from Spain, Southern France, Italy, Denmark, the Balkans, Asia Minor and Syria; within the boundaries of the USSR the species is known from the Crimea and the Transcaucasus.

For help and direction of the work I express deep gratitude to V. V. Popov.

SUMMARY

Investigations of the nesting habits of Halictus maculatus Sm. were carried out in summer 1958, in the village of Borisovka of Belgorod region.

Two nests were examined. The construction of the first nest, situated on the slope of a low hill, was very simple. From the entrance, lying in the center of a small hill, a vertical passage with a small elbow-shaped bend extended 6.7 cm deep. Farther on, the passage proceeded vertically. The total length of the passage was 16 cm. The construction of the second nest was more complicated. It consisted of 7 passages with many cells (42). The main passage (5 mm diameter), originating from the inlet, went into the ground (7.5 cm) at a low angle. Afterwards the 7 passages, lying on different planes, branched out from it. At the end of the seventh passage there was found a female of a parasitic bee Sphecodes subovalis Schok.

According to investigations of material obtained in Borisovka, Halictus maculatis Sm. is supposed to possess two generations.

Species polytropic: in Borisovka they were recorded on 35 species of plants from 11 families.

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ON THE CULTIVATION OF INSECT TISSUES IN VITRO

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Research on methods of culturing insect tissues was begun about 40 years ago (Goldschmidt [1915, 1916, 1917]; Lewis and Robertson [1916]; Glaser [1917]), when many of the problems of histogenesis and the behavior of various cellular elements in vitro were explained. These same techniques have proved useful, not only in carrying out histo-physiological investigations, but also for the resolution of certain general biological problems and, in part, in the field of virology; so far, however, they have not been used as widely as they might. We are aware of a single report, (Trager [1935]), of the successful cultivation of an insect virus (from the mulberry silkworm) by an in vitro tissue technique and a later repetition of the technique with the same virus (Wyatt [1956]).

The author decided to attempt a simpler method of tissue culture, in order that the cultured tissue might serve as a substrate for the multiplication of viruses causing polyhedral disease of insects. It was noted that one of the most characteristic peculiarities of various cultured tissues was the absence of typical zones of growth. In the cultivation of fragments of organs, which include in their composition connective-tissue cells, e.g., butterfly wing rudiments (Kharin [1930]), ovarian tissue from lepidopteran larvae and pupae (Trager [1935]; Khozinskii [1950]), the "cellular zone" which arises around the explant is largely formed from connective-tissue cells which have migrated there; no mass multiplication of the latter by mitosis has been observed. In certain cases, however, amitotic production of new connective tissue cells has been noticed.

Mitotic production of testicular cells in grasshoppers was noticed by Lewis and Robertson [1916] and Bělař [1929] in their experiments, some time after the tissue had been transferred to a hanging drop of Ringer solution; they described this phenomenon, however, as a continuation of the process which had begun in the intact insect.

A limited amount of multiplication has been observed among tissue cells in hanging-drop culture and among hemolymph cells by Glaser [1917]; Lazarenko [1925]; Taylor [1935]; Vermel [1938 a,b] and others. In such cases the characteristic feature of multiplication was the formation of a syncytial structure which migrated over the congealed substrate or the cover glass. Vermel described their in vitro transformation of proleucocytes and macronucleocytes and their later settling down as stellate cells.

In certain experiments epithelial cells have also been observed to migrate into the surrounding medium, for example, those of cockroach Malpighian tubule explants in liquid or saline medium, solidified by the addition of heterogeneous plasma (Kharin [1930]), and also those of wing epidermis from Antheraea polyphemus pupae undergoing diapause, in synthetic medium T. C. 199 as employed for invertebrate tissues (Loeb and Scheidermang [1956]). The absence of mitotic activity was explained by these authors as resulting from an insufficiency of nitrogen-containing food or the lack of growth hormone in the medium.

Recently, Schmidt and Williams [1953] have successfully demonstrated by tissue culture methods that the hemolymph of the silkmoths Platysamia cecropia L. and Samia walkeri Feld (Cynthia Dryry) contains a hormone for growth and development, which is elaborated by the prothoracic glands of the larvae and developing pupae. Such hemolymph was found to be an adequate medium for the maturation of spermatocytes and for the mitotic division of blood cells and spermatogonia. The same authors showed that the hemolymph from a pupa undergoing diapause was inactive as a result of the presence in it of a "development-inhibiting" hormone secreted by the corpora allata. The maturation of testicular cells from the pupae of Platysamia cecropia L. in hanging-drop hemolymph culture was accomplished by Goldschmidt between 1915-1917; in this medium unusual growth of the follicular cells was observed in testis explants but no mitoses took place. In Loeb and Schneiderman's experiments [1956] fragments of lepidopteran wing rudiments in hemolymph from developing pupae rapidly underwent degenerative changes. Equally unsuccessful were the experiments of Goodchild [1954], who used explanted fragments of various organs, including the gonads of nymphal Rhodnius prolixus Stal bathed in hemolymph drawn from the same species.

From these references it is obvious that hemolymph is not a universal nutritive medium and that different tissues from one and the same insect may require specific conditions for their successful cultivation.

It is possible that the most favorable nutritive medium for insect tissues is that suggested by Wyatt [1956] and consisting of a large number of synthetic amino acids of the same kind as occur in hemolymph, to a solution of which a small quantity of natural hemolymph has been added as a source of growth hormone. Wyatt's

experiments showed that, when cultured in this medium, fragments of ovarian tissue from lepidopteran larvae and pupae invariably extruded cells from the ovarian tubules into the medium ,and these cells underwent intensive mitotic division. The duration of such a culture increased from Trager's time of 1-2 weeks to 3 weeks, when a salt solution with added glucose was used.

The essential steps in devising a method of culturing insect tissue was taken when, by some means or other, the tyrosinase in the hemolymph was inactivated either by heating or by the addition of a specific tyrosinase inhibitor, phenylthiourea.

METHOD

The material employed in these investigations was male and female gonadial tissue from pupae of the Mulberry Silkmoth (Bombyx mori L.) and the Oak Silkmoth (Anthereaea pernyi Guér.). The removal of the gonads from the sterilized pupae was accomplished by washing them off into the physiological solution and nutrient medium. A small drop of the solution containing the seminal cyst or ovarian fragment was then suspended from a cover glass, which in turn was mounted on a microscope slide and hemetically sealed with molten wax.

A 302 mixture of hemolymph in Clark or Ringers salt solution, or Tragers nutrient sugar solution , or pure hemolymph, was used as a nutrient medium.

The hemolymph was collected in sterile centrifuge tubes immediately after its withdrawal from the incised heart. The tyrosinase in the hemolymph was inactivated by heating . It was established empirically that the hemolymph from A. peryni pupae required to be heated to a temperature of not less than 60° for 10 minutes before its tyrosinase was fully inactivated; hemolymph from B. mori pupae required a somewhat lower temperature (54-55°) but a longer time - not less than 15 minutes. After inactivation of its tyrosinase the hemolumph was centrifuged in order to bring down its white cells and other blood elements.

The cultures were maintained at room temperature or 25-26° and from time to time they were examined under the microscope at a magnification of x 1350. In order to prepare histological sections, some of the material was fixed in its wet state using formaldehyde and acetic acid vapor and additional treatment with methyl alcohol.

In certain cases smears were prepared, and these were fixed in a dry condition.

The preparation were stained with hematoxylin (hemalum) and eosin.

RESULTS

At the commencement of metamorphosis, almost all the male generative cells in the pupae of A. pernyi are to be found as late spermatogonia or primary spermatocytes; the majority of cysts are of a rounded form.

In pupae of B. mori, the testes possess a considerable number of elongate cysts, which at that stage already consist of spermatids in various stages of differentiation.

On placing the cyst in a hemolymph – salt - solution mixture, active changes may be observed both on the part of the membrane and also by the cells undergoing spermatogenesis. The most marked changes were observed in media composed of 1 part hemolymph and 2 parts Clark or Ringer's solution diluted with an equal volume of distilled water, and in media containing a mixture of 10% hemolymph in Trager's solution.

The cytoplasm around the depressed nuclei of the testicular membrane swells up and forms bulges, from which arise short outgrowths; at various points on the capsular surface there are formed long, branching transparent processes, or alternatively, broader outgrowths, which on warming the culture may be withdrawn rapidly and thrust out again a short time later. Sometimes, there is formed around the cyst a transparent edging of variable form and then the cyst may begin to move, as a consequence of its thrusting out pseudopodia (Fig. 1).

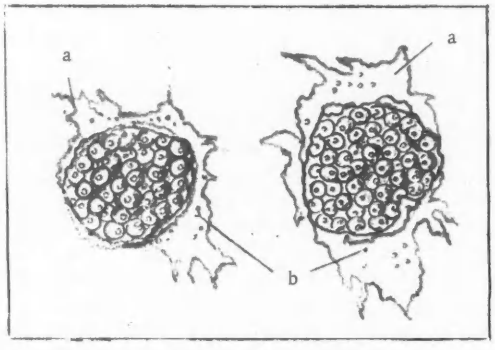

Fig. 1. Seminal cysts from A. pernyi pupae (x 10 eyepiece, 20 objective). Living 5-day-old culture: a) transparent border with amoeboid processes; b)phagocytized bacteria

Elongation of the cyst is achieved by a characteristic separation from its membrane of independent cells of large size, i.e. the phenomenon of "shedding" (Fig. 2.A, a). At the same time, such cells become filled with fat droplets and closely resemble cells of the fat body ; it is possible, however, that this phenomenon may represent fatty degeneration of the cells. The slipping of the membrane to one end of the cyst may be frequently observed; it is then transformed into a collection of large, discrete cells, which correspond in number to the number of nuclei (8-10), in the original membrane (Fig. 2.B).

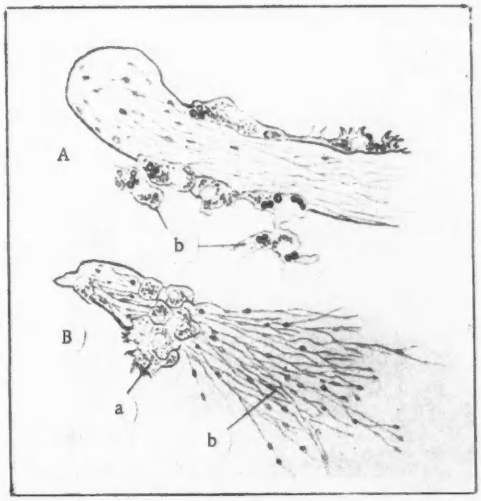

Fig. 2. Elongated cysts from A. pernyi pupae (× 10 eyepiece, 20 objective). Living 1-day-old culture A) cysts with membrane undergoing distension (a - "shedding" of large cells from membrane); B) slipping of membrane cells to one end of cyst, (a – pile of membrane cells, b extrusion of spermatids from cyst).

The cells undergoing spermatogenesis show a tendency to emerge from the cyst into the surrounding medium. They spread to the cyst boundary as conical or finger-like, transparent processes of various lengths and changeable form; these processes undergo an oscillatory type of movement, first advancing, then receding, and so on. By the end of the first few days of culture, the majority of cells have emerged completely from the cyst. During the first day, the spermatogonia, and possibly the spermatocytes assume the capacity to undergo amoeboid movement and phagocytosis, in the same way as do the membrane cells. The spermatogonial cell thrusts out one or another of its filiform process in the direction of any bacteria in the medium; the moment the tip of the process reaches the bacterium, the latter is engulfed and a large vacuole is formed round it. In other cases, the outgrowth rapidly disintegrates any bacteria in its immediate vicinity by surrounding them and withdrawing the vacuole thus formed well into the substance of the cell. This rapid disintegrative reaction indicates a high degree of contractility on the part of the cytoplasm.

When the cells undergoing spermatogenesis emerge from the cyst membrane, they coalesce and acquire the

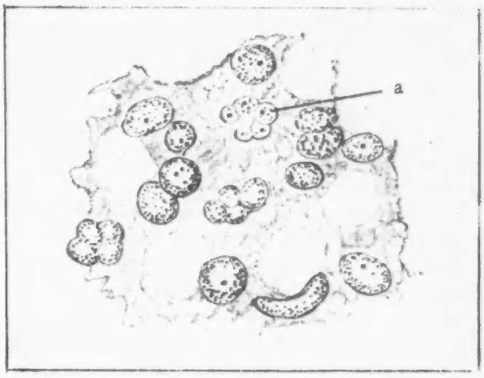

Fig. 3. Section of the growth developed from the membrane of a seminal cyst from a B. mori pupa (Stained hemalum-eosin; ×10 eyepiece, 1/12 oil - immersion objective) 16-day-old culture: a) fragmentation of nucleus.

form of an irregular clump, having the structure of a syncytium; moreover this syncytial mass acquires a considerable capacity for contraction and general mobility. After approximately 10 days at room temperature and somewhat earlier at 25°-26°, the mobility of the cyst membrane cells and the spermatogenic cells ceases.

The cyst membrane acquires its peculiar capacity for expansion very rapidly and soon forms a large vesicular protrusion. After a few days the culture shows a quite different body, composed of interlacing cytoplasmic strands and large nuclei, in place of the original cyst. This body has, to a greater or lesser degree, the structure of a disintegrated syncytium with a large number of nuclei, and it may possess 30-35 nuclei in addition to the 8-10 from the membrane of the original cyst (Fig. 3). When several membranes fuse together there is formed a large conglomeration, composed partly of cells undergoing spermatogenesis, partly of whole cysts, together with degenerating cells and those still alive.

The nuclei of the cyst-membrane derivative are, for the most part, large but sometimes smaller nuclei are to be found and even very small nuclei may occur; they frequently have clearly defined chromatin granules. In so far as we have never observed any mitosis, it would appear that the nuclei divide amitotically by fragmentation, and this process is demonstrated by stained preparations in which the separate nuclear fragments are clearly visible (c.f. Fig. 3). Normal nuclei can be detected in cultures of not less than a month old; nuclear fragmentation takes place at least during the 15th to 20th day.

With the passage of time the tissue cultures undergo degeneration, although the spermatogenic cells live for several months or even longer. However, their multiplication is not accompanied by the normal morphological changes associated with spermatogenesis as it would occur within the cyst. As a consequence, there may arise in the culture a considerable number of small cells with homogeneous cytoplasm staining intensively with eosin, and darkly stained nuclei. In certain cultures, in which the nutrient medium employed was hemolymph, it was noticed that survival lasted as long as 5 months.

Explants of ovarian fragments in Trager's glucose/salt solution with 10% hemolymph show an immediate migration of cells lining the inner surface of the ovarian tubules; these cells, which are filled with eosinophilous granules, attach themselves to the surface of the cover glass or microscope slide as a result of some thigmotactic response on their part; the attachment is achieved by means of processes thrust out from the cells and later these same processes by fusion form a thin syncytial network over the glass surface. The further destiny of such

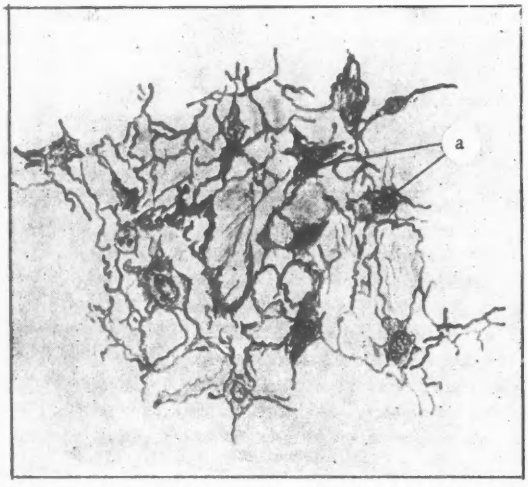

Fig. 4. Fibrous connective tissue, forming from a syncytium (Stained hemalum-eosin; eyepiece ×10, objective 1/12 oil immersion). An 85-day-old culture of cells from the ovarian tubules of a mulberry silk moth pupa: a) degenerating nuclei.

syncytia varies from one individual case to another; whereas certain cultures undergo a rapid degeneration (as reported in previous papers), in other cases the plasmatic processes become transformed into very fine fibers, in the mesh of which lie the degenerating nuclei. Thus, in an 85-day-old culture, in which the majority of the nuclei have degenerated, a protoplasmic network is to be seen (Fig. 4).

Rather different behavior of cells is found among cultures in salt solutions containing up to 30% hemolymph, or in whole hemolymph. The cells, which become filled with fat droplets and increase in size, do not always perish; many of them, on the other hand, persist for several days or even longer and multiply by multiple fragmentation, or by so-called endomitosis (Fig. 5). Evidently, all the maternal cells are capable of giving rise to daughter cells, but it frequently happens that in the process the central part of the cytoplasm disintegrates with consequent death of the cell. The process of fragmentation may be discerned readily in both living cultures and fixed preparations. As a result of this process, the cultures contain many small, light-colored cells, with finely granular cytoplasm.

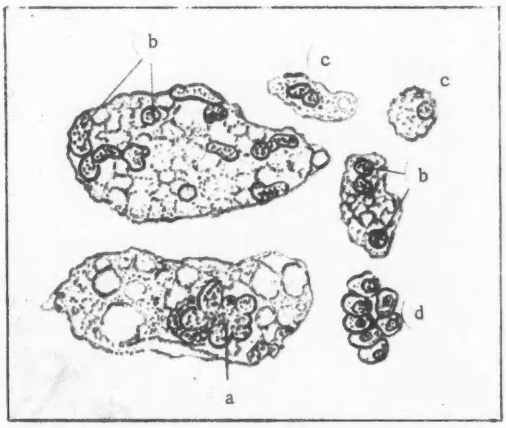

Fig. 5. Connective tissue cells from ovarian tubules of mulberry silkmoth pupae (Stained hemalum-eosin, eyepiece × 10, oil immersion objective 1/12). 158-day culture: a) fragmentation of nuclei; b) nuclear fragments, scattered throughout maternal cell; c) daughter cells; d) groups of daughter cells, which preserve the general configuration of the maternal elements.

The culturing of ovarian tubule cells in hemolymph or in salt solutions to which has been added a considerable amount of hemolymph promotes the longevity of the culture (up to 5 months or more). However, with the passage of time, the multiplicative intensity of the cells diminishes; although in 7-month-old cultures it is quite common to find cells with two, three or even four nuclei, the phenomenon of fragmentation is rare. The addition of fresh nutrient medium brings about a renewed multiplication of the cells, together with an increase in degeneration.

DISCUSSION OF RESULTS

The literature on tissue cultivation shows that in certain cases the tissue may continue to survive under culture conditions without it undergoing any noticeable change. Thus, in Kharin's experiments, using fragments of cockroach Malpighian tubules, the tissue was found to survive for 70 days; fragments of hypodermis from the wing rudiments of the moth, Phalera bucephala L. — were also found to survive for a long time without undergoing any change.

Schmidt and Williams note that blood cells of Lepidoptera, transferred to inactive hemolymph from pupae in a state of diapause, survived for several months. In all these cases, when the elements of the tissue explant manifested any kind of activity (migration, multiplication, spermatogenesis), degeneration of the culture set in within 1-3 weeks, even if the nutrient medium was renewed periodically. The early work of Goldschmidt revealed that blood and follicular cells lived and multiplied in hemolymph for more than 6 months.

Under the conditions we have described it has proved possible to maintain a living culture of cells migrating from ovarian tubules for 7 months, without changing or renewing the nutrient medium. The addition of fresh medium was the signal for a mass multiplication of cells with the consequent production of a population of younger elements. Thus, the cells have not simply survived in vitro, but have undergone a gradual and irreversible degeneration, at the same time preserving their capacity to multiply when conditions become more favorable. As a consequence of this, the cells retain complete viability for a period of time which is far in excess of the normal life span of the insect (not counting the period of diapause).

The growth and extension of the seminal cyst membrane, which we obtained in our experiment, had been observed as early as 1916 by Goldschmidt. The essential adaptation, common to both cases, is the method of nuclear division by fragmentation. A critical factor is the continuous relationship between the processes of regeneration and degeneration which results from the renewal of the culture medium. At an earlier date we described the multiple fragmentation of the nucleus in the hypodermis of the mulberry silkmoth pronymphal stages (Medvedeva [1944]).

The extension of the cyst membrane as a result of a considerable amount of intensive nuclear division serves as a suitable object for culturing viruses.

The ability of the cells wich migrate from ovarian tubules to form an itercellular fibrous tissue in vitro, shows their affinity with connective tissue elements. We have demonstrated that these particylar cells are filled with eosinophil granules, (which testifies to the albuminous nature of the latter) and hence the cells must be regarded as performing the part of a food depot for the developing oocytes. According to Vermel [1938] these mesenchymatous elements, by undergoing a partial differentiation give rise to the stroma of the ovary and he terms them "nexocytes".

The considerable contractile ability possessed by the cytoplasm of the seminal cyst membrane and by the spermatogenous cells in their early stages, during the first day of development in the explant, is an expression of the phagocytic properties of these elements. This, together with their ability (which is shared by the connective tissue elements of the ovarian tubules) to multiply by means of fragmentation, shows a low degree of histo- and cytological differentiation, a factor which is of undoubted importance in ensuring their successful cultivation in vitro.

SUMMARY

1. When cultivating under the conditions of hanging drop of oviducts in hemolymph or in salt medium (Clark, Ringer, Trager) with an addition of hemolymph (up to 30%) the cells migrating from oviducts preserve the vitality for up to 7 months. Renewal of the medium raises an outbreak of reproduction processes, which occur at the same time with degeneration of old cells.

2. When cultivating under the same conditions of testicular cysts in mixtures of salt solution with hemolymph (30 %), the cyst membranes, when germ cells are out, show a peculiar growth: On the place of cysts, separate bodies with more or less friable syncytial structure and with a great number of big nuclei are formed.

3. In the very first days of cultivation of testicular cysts, their membrane, immature spermatogene cells as well as immature cysts show a considerable mobility and phagocytic activity.

4. Reproduction processes observed in cultures are a special form of direct division, the fragmentation of a nucleus being the basis of the process.

5. Syncytial cells can convert into fibrous tissue. This phenomenon confirms the connective-tissue nature of cells lining the oviducts. In an intact insect they play a role of a food depot for developing eggs.

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THE STRUCTURE OF THE INSECT BRAIN DURING SUCCESSIVE STAGES OF POSTEMBRYONIC DEVELOPMENT. III. OPTIC LOBES

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1. Composition of the Optic Lobes of the Imago.

In most insects each optic lobe consists of three neuropile masses with the nerve cells pertaining to them; these are the first optic ganglion (lamina ganglionaris), distal in position, the second optic ganglion (medulla externa) and, finally, the third optic ganglion (medulla interna), the most proximal in position (Fig. 1)

The composition of the first optic ganglion includes a layer of outer nerve cells (Inc_1), fibrous matter with a palisade structure (I), and a layer of inner nerve cells (Inc_2) which is, however, much less developed than the layer of outer cells.

The fibers emerging proximally from the first optic ganglion cross each other, forming the so-called outer chiasma (ch. ext.). After the chiasma the nerve fibers penetrate the second optic ganglion, which, like the lamina ganglionaris, consists of three layers—the outer and inner layers of nerve cells ($IInc_{1,2}$) and the layer of fibrous matter ($II_{1,2,3}$). As a result of the strict regularity of the orientation of its included fibers, the neuropile of the second ganglion displays two types of striations in sections. A transverse striation ($II_{1,2}$) is formed by fibers penetrating the ganglion from its long sides, while a longitudinal striation (III_3) is formed of prolongations of large nerve cells lying anteriorly and somewhat medially from the ganglion ($IIInc_3$). These cells connect the second optic ganglion directly with the protocerebral lobe.

The bundles of fibers connecting the second ganglion with the third also cross each other. This inner chiasma (ch. int.) is formed of extensions of neurones belonging

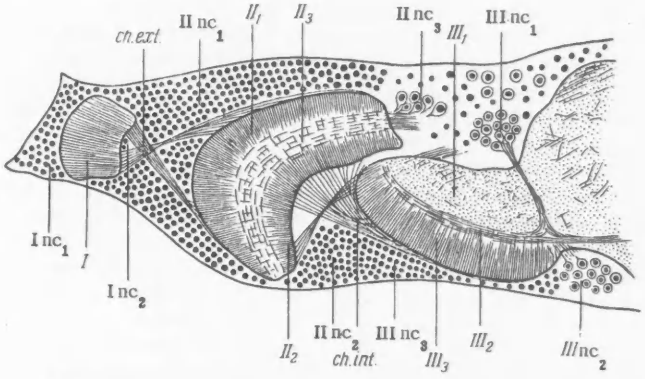

Fig. 1. Diagram of the structure of the optic lobe of an insect. I) First optic ganglion; Inc_1) outer neurones of first ganglion; Inc_2) inner neurones of first ganglion; II) second optic ganglion; II_1) outer palisade layer of second ganglion; II_2) inner palisade layer of second ganglion; II_3) layer of longitudinal fibers of second ganglion; $IInc_{1,2,3}$) corresponding groups of nerve cells; III) third optic ganglion; III_1) zone of the homogeneous neuropile of the third ganglion; III_2) longitudinal fibers of third ganglion; III_3) palisade layer of third ganglion; $IIInc_{1,2}$) nerve cells of longitudinal fibers; $IIInc_3$) nerve cells of palisade layer; ch. ext.) outer chiasma; ch. int.) inner chiasma.

to the third optic ganglion and situated behind the latter ($IIInc_3$). Furthermore, there are cells belonging to the third ganglion located anteriorly to it and also between it and the protocerebral lobe ($IIInc_{1,2}$). It is by means of the extensions of these cells that a connection is effected between the third optic ganglion and the rest of the brain.

As in the second optic ganglion, the fibers within the medulla interna run in two mutually perpendicular directions. Consequently here also the neuropile shows a longitudinal and transverse striation and is divided into a zone of homogeneous neuropile (III_1), a layer of longitudinal fibers (III_2), and a palisade layer (III_3).

This is the most complete structure of the optic lobes and is found in those instances where the visual organs are sufficiently developed. A simplification of these organs is accompanied by a gradual reduction of the centers (Wundrig [1936]). In such cases the first thing observed is incomplete development of the third optic ganglion, which acquires the appearance of a minor lateral process of the main protocerebral lobe.

2. The Developmental Origins of the Optic Lobes

It is well known that in the embryo the entire protocerebrum is laid down as three pairs of lobes arranged transversely to the germ band. Of these, the first and most lateral lobe and part of the second lobe of the protocerebrum participate in the formation of the optic lobes. The third pair of lobes, together with the rest of the second, form all of the remainder of the protocerebrum (Viallanes [1891]; Wheeler [1893]; Heymons [1895]). The embryonic elements of the second and third lobes are represented by single neuroblasts, which produce colonies of daughter cells, and are identical to the single neuroblasts of the ventral nerve ganglia. The first pair of lobes differs from the other two in that there is never observed within it a regular production of daughter cells in the form of colonies headed by separate neuroblasts. This lobe becomes differentiated early from the outer dermatogenic layer and consists entirely of cells of characteristic form called "gangliogenic cells" by Viallanes. These differ considerably from the solitary neuroblasts in outward appearance and initially multiply, increasing considerably in number, only then beginning to produce nerve cells which surround the developing first and second optic lobes. In addition, in some cases a few solitary neuroblasts also take part in the formation of the first lobe (Heymons [1895]).

Accumulation of gangliogenic cells continues in the first lobe even during the postembryonic period. This was first observed by Bauer [1904], who called it the first formative aggregation of the optic lobes.

The third optic ganglion arises in the lateral portion of the second protocerebral lobe, the embryonic elements of which, as we have already said, are represented by solitary neuroblasts. Furthermore, even during the earlier stages of development of the protocerebrum, between its first and second lobes, there occurs an invagination of ectodermal cells, which remain associated with the ectoderm for a very long time. The inclusion of this invagination in the structure of the brain takes place during the late stages of development. At this time it is situated at the anterior surface of the third optic ganglion. The first investigators to observe this invagination (Viallanes [1891]; Wheeler [1893]; Heymons [1895]) could not correctly interpret its significance. Only Bauer demonstrated that it is identical with the second aggregation of neuroblasts in the optic lobes, which is observed during the preimaginal period in insects.

The early authors did not give detailed consideration to the structure of these accumulations of embryonic cells. For instance, Viallanes, in the work mentioned above, merely mentioned the fact that the gangliogenic cells initially proliferate without thereby changing form. Immediately after this there ensues a period during which they begin to produce smaller cells, poorer in cytoplasm, which Viallanes called "nerve cells". The latter in their turn actively multiply "by themselves". As the nerve cells multiply, the gangliogenic cells cease dividing and gradually die off, disappearing completely in the fully formed Mantis embryo.

Wheeler [1893] describes only the division of the solitary neuroblasts. The latter divide, forming a daughter neuroblast and another daughter cell which in Xiphidium becomes immediately transformed into a nerve cell. Wheeler was able to observe the division of small daughter cells in Doryphora as well. This author unfortunately did not indicate whether the nature of the embryonic cell division in the first protocerebral lobe differs from that of the solitary neuroblasts.

By the same token Bauer, after investigating the embryonic elements of the brain, admittedly during the postembryonic period, did not discuss the difference between the neuroblasts of the formative aggregations, or proliferation centers, of nerve cells and solitary neuroblasts. He described only the unequal mitosis of the latter with the formation of a so-called ganglionic mother cell and a daughter neuroblast. The ganglionic mother cells, according to Bauer, divide equally to form two cells, which then differentiate into neurones. This system was carried over by Bauer to the neuroblasts of the proliferation centers as well.

Subsequently a whole series of authors related all the processes of proliferation of embryonic elements of the brain to this particular scheme (Corneli [1924]; Umbach [1934]; Pyle [1945]).

However, other authors who carried out special investigations of the development of the optic lobes obtained results which were completely contradictory in this respect. In nerve cell proliferation centers in the optic lobes of Gyrinus natator L. larvae, Bott [1928] noted equal divisions of neuroblasts, which produced two ganglionic mother cells. In this connection he refers to Figure 75 of his work, where two neuroblasts in metaphase

are illustrated, to verify the equality of the division. However, in my opinion it is impossible to judge from the mitotic configuration at this phase what the products of division will be. Therefore it seems to me that the course of nerve cell formation in the optic lobe of Gyrinus was not fully elucidated.

Approximately the same point of view as that of Bott was taken by Grabenhorst [1930], who studied the optic lobes of may-fly nymphs and thus discovered great differences in nerve cell formation processes in different species of nymphs. In Cloëon, Granbenhorst distinguishes two types of neuroblasts. Large neuroblasts occupy the greater part of the proliferation center and divide equally to form two daughter neuroblasts, which may divided again in the same way. At the edge of the proliferation center there are some neuroblasts of somewhat lesser size associated with nerve cells. According to Grabenhorst these also, although with the formation of a smaller spindle, divide equally into cells which are of a structure different from that of neuroblasts and which are not arranged in a dense layer. By secondary division these cells give rise to the definitive ganglionic cells. Thespindles formed during division of these primary ganglionic cells do not differ in size from those of small neuroblasts. Unfortunately Fig. 4 of Grabenhorst, like that of Bott, shows phases of division during which it is not yet possible to judge whether an equal or unequal division is taking place.

Grabenhorst also describes a similar sequence of nerve cell formation in the optic lobes of Ecdyonurus, where there are also both neuroblasts and primary ganglionic cells present. These and others divide equally.

In Leptophlebia, according to this author's data, the process of nerve cell formation takes on a step-like character. Thus in the optic lobes of Lepthophlebia the first thing that is observed is a strong proliferation of the neuroblasts of the outer proliferation center; these do not fill the entire area which will later be occupied by the first optic ganglion. Then the neuroblasts form the primary ganglionic cells by division and these similarly become transformed into ganglionic cells proper. Grabenhorst associates this feature with the fact that in this species the telescopic eyes of the males are laid down suddenly, and not gradually as in Cloëon and Ecdyonurus.

Finally, according to Schrader [1938], the formation of the nerve cells of the optic lobes in Ephestia kuhniella Z. takes place in the following way. In the larvae of the first two instars,neuroblasts proper are absent, while the future centers of proliferation are laid down from undifferentiated cells, the nuclei of which contain chromatin which remains evenly and thinly distributed, the nucleoli being as yet indistinguishable. During the course of the larval stage they give rise to equal products of cell division and finally form extensive proliferation centers for cells of the imaginal optic centers. These cells Schrader calls "protoneuroblasts". Even before the prepupal period, later during this period, and then even in the pupa, in the marginal area of the proliferation center these cells differentiate into neuroblasts which give rise to ganglionic mother cells by means of repeated unequal divisions. Soon after pupation each ganglionic mother cell begins to divide into two ganglionic cells.

If we now compare the statements of the authors mentioned, it appears that they all recognize the presence of three principal genetically related groups: neuroblasts, maternal or primary ganglionic cells, and cells which differentiate directly into neurones. The opinions of these authors differ on the manner in which particular elements divide and on whether differentiation of the neuroblasts themselves takes place.

Because of the ambiguity of these questions it became necessary to recruit additional material in order to discover the fate of the cells in the proliferation centers of the optic lobes. For this purpose I examined various stages of postembryonic development in the optic lobes of Apis mellifica L., Pieris brassicae L., Aeschna sp., Tettigonia viridissima L., and Siphlonurus sp. The results of these observations are presented below.

The first aggregation of neuroblasts in the optic lobe of the honey-bee(Fig. 2) is represented during the entire course of the larval stage by a very distinct formation situated at the extreme lateral portion of the lobe. The most lateral part of the aggregation is sharply delimited from the neighboring nerve cells and consists of neuroblasts (nb_1) which are distinctly smaller than the solitary neuroblasts, which are scattered over the entire brain. The mitosis observed in this zone of the aggregate form equal products (mt_1). Two daughter neuroblasts result. The axis of the cell division spindle thus formed is always oriented along the longitudinal axis of the neuroblast layer or at a slight angle to it.

The more medially situated area of the aggregation consists of neuroblasts which differ from those of the first zone by the larger size of their nuclei, their more rounded form, and the abundance of their light-colored cytoplasm (nb_2). The axis of the cell division spindle of these neuroblasts is always oriented transversely to that of the neuroblast layer, while the mitosis is unequal in its products (mt_2). As a result of this division two daughter cells are formed, the larger of which grows to the size of a mother neuroblast and the smaller of which enlarges very little, becoming a ganglionic mother cell (mgc). The latter divides evenly in its turn and forms even smaller daughter cells (mt_3). In the zone of the latter (nc) mitosis is no longer observed.

The dimensions of the types of cells mentioned above are presented in the table on page 60.

It should be pointed out that the regions containing the neuroblasts of the two types mentioned above are not sharply delimited from each other. The middle zone of the center contains cells of an intermediate

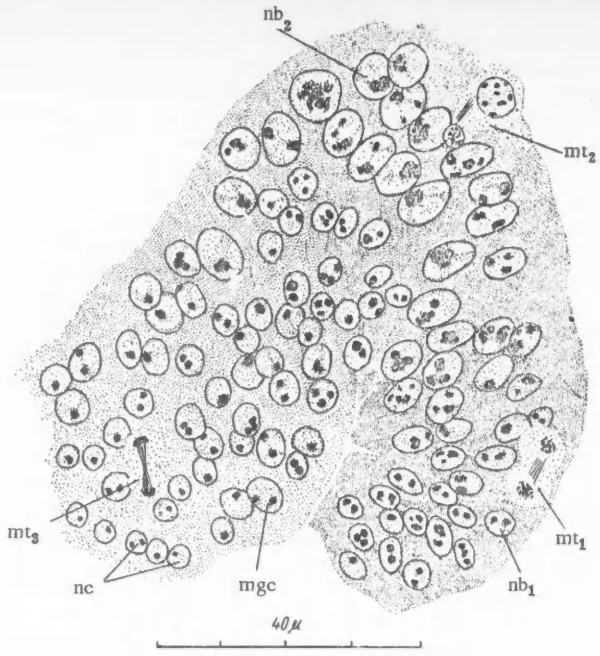

Fig. 2. Structure of the first aggregation of neuroblasts in the optic lobe of the prepupa of Apis mellifica L. nb_1) Neuroblast of the first type; nb_2) neuroblast of the second type; mgc) ganglionic mother cell; mt_1) division of neuroblast of the first type; mt_2) division of neuroblast of the second type; mt_3) division of ganglionic mother cell; nc) nerve cell.

character which do not divide evenly, but which are still larger than evenly dividing neuroblasts.

The structure of the first aggregation of neuroblasts in the optic lobes of the prepupa of the cabbage butterfly and the nymph of Aeschna isso similar to that of the honey-bee that it does not need special description.

The first aggregation of neuroblasts in the optic lobes of the second instar nymph of Tettigonia viridissima (Fig. 3a) is a distinctly less conspicuous formation than that of the honey-bee and cabbage butterfly larvae. During the postembryonic period it is only a small remnant of the neuroblasts which had multiplied very rapidly in the first protocerebral lobe of the embryo. During the nymphal period the aggregate consists of a comparatively few large neuroblasts (nb) and smaller ganglion mother cells (mgc). The nuclei of the neuroblasts are completely diverse in form and relatively poor in chromatin, which is distributed within them as a small granule. One can always distinguish within the latter, one or rarely two nucleoli of globular or flattened form.

Ganglion mother cells are situated around the neuroblasts. They are poorer in cytoplasm than the neuroblasts, but their nuclei, though usually smaller, sometimes reach the size of neuroblast nuclei. However, it is always impossible to confuse the nuclei of these two types of cells, since those of the ganglion mother cells are unusually rich in chromatin, which almost completely fills the nucleus in the form of large granules.

Finally, along the periphery of the proliferation center there are the usual nerve cells of the optic lobe (nc), these being smaller than the mother cells and intermediate in the chromatin content of the nucleus between the latter and the neuroblasts.

One may observe within the proliferation centers a whole series of mitoses differing both in the size and the direction of axes of the spindles. The axes of the neuroblast spindles may be oriented perpendicularly to the long axis of the layer or parallel to it. The first orientation is always observed in the central part of a transverse section through the center of proliferation (Fig. 3b mt_1), while along the sides, the axes of the spindles are oriented in either direction (Fig. 3c, mt_1). In this case mitosis is always equal.

When the axis of the spindle is perpendicular to the long axis of the layer of neuroblasts one product of the division remains in the old location, while the other

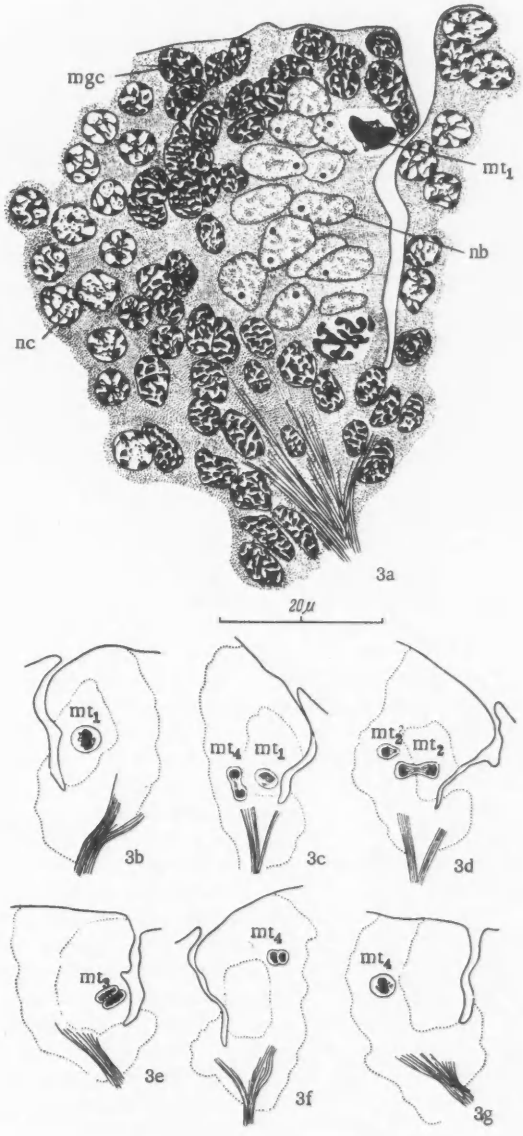

Fig. 3a – 3g. Structure of the first nerve cell proliferation center in the optic lobe of the nymph of Tettigonia viridissima L. nb) Neuroblast; mgc) ganglion mother cell; $mt_{1,2,3}$) neuroblast cell divisions; mt_4) ganglion mother cell divisions; nc) nerve cell.

Cell type	Interkinesis (diameter of nucleus)	Metaphase (diameter of cell)
Neuroblast of first zone	4.1 microns	9.4 microns
Neuroblast of second zone	6.6 "	10.1 "
Ganglion mother cell	4.2 "	6.8 "
Nerve cell	3.9 "	—

daughter cell migrates to the zone of the ganglionic mother cells. This sort of cell division is the one most frequently seen (Fig. 3d, mt_2).

On the other hand, I once found two recently formed cells, the position and size relationships of which attested to the fact that even in the central part of the layer, neuroblast sometimes divide in such a manner that both daughter cells remain among the neuroblasts (Fig. 3e, mt_3). We may suppose that in this way an increase in the number of neuroblasts may take place or, at least, that losses due to various causes may be made up.

The spindle formed during division of the ganglionic mother cells may apparently have any orientation. Their equatorial plate is somewhat smaller than that of the neuroblasts. The daughter cells are also of equal size (Fig. 3c, 3f, 3g, mt_4).

In my opinion, on the basis of the foregoing we may outline the process of nerve cell formation in the optic lobes of the katydid in the following manner. The first stage is the division of neuroblasts. The results of this division are a daughter neuroblast and a ganglion mother cell or, as observed more rarely, both daughter cells may be neuroblasts. The products arising are equal in size, but if the cell moves out of the confines of the neuroblast layer it grows to somewhat smaller size than a neuroblast. The neuroblast repeats these divisions anew, while the ganglionic mother cell divides evenly in its turn, forming two cells. It is difficult ot say whether these cells divide again or whether they immediately transform into optic lobe neurones.

In the nerve cell proliferation centers in the optic lobes of Siphlonurus, I was likewise unable to separate two zones of neuroblasts. The mitotic divisions found within them were of two sizes, the smaller apparently belonging to the ganglionic mother cells. During anaphase the mitotic divisions seemed equal or slightly unequal.

* * *

Thus, the data obtained from observations made so far tend to support the idea that the formation of nerve cells in the optic lobes proceeds differently in different insects, sometimes even in those closely related. It is also true that we see many common features, for instance, the presence of three types of cells: neuroblasts, ganglionic mother cells, and nerve cells proper; and the division of neuroblasts into two categories — those belonging to one of those which divide into two daughter neuroblasts, and those in the other category, which form a ganglion mother cell.

The most widespread means of nerve cell formation is apparently that first described by Schrader in the Mediterranean flour moth and also discovered by us in the honey-bee, cabbage worm, and Aeschna.

Although Viallanes [1891] and Wheeler [1893] wrote that the neuroblast proliferation centers in the optic lobes of hemimetabolous insects cease to produce nerve cells and almost completely degenerate at the end of embryogenesis, Bauer [1904] observed numerous cell divisions of neuroblasts and ganglion mother cells in the optic lobes of full-grown Aeschna sp. nymphs and young Machilis, while Graichen [1936] succeeded in observing them in the brain of adult Nepa cinerea L. also. I have observed neuroblast division in the optic lobes of all nymphal instars in many species of katydids and, in Tettigonia viridissima L., even in the adults. In the latter case aggregations of neuroblasts in the optic lobes were found in all thirteen of the available series of sections. Degeneration of cells was always observed, and in ten of the series dividing cells were also found in the aggregations.

The continued formation of nerve cells in the optic lobes of hemimetabolous insects during the postembryonic period is evidently associated with the fact that growth of the compound eyes continues during this time in these insects (Jorschke [1914]) with a zone of formation of ommatidia along the median edge of the eye.

In the may-flies the neuroblasts of the optic lobe disappear in the full-grown nymph, as Grabenhorst has already pointed out.

In the brain of larvae of Oligoneoptera the proliferation centers exist during the course of the larval, prepupal, and part of the pupal stages of development. However, although the mitotic acitivity is of their neuroblasts it is not the same in different periods of postembryonic development. In those larvae which are provided with stemmata, some retardation in the development of the proliferation centers is observed during the larval period (Schrader [1938]), with very rapid activity during metamorphosis. I did not observe this periodicity in the honey-bee, probably because of the specificity of the way of life of the larvae, which are thus able to

develop imaginal structures during the course of the entire preimaginal period of ontogenesis. The peculiar development of the imaginal optic centers in Culex pipiens L., which appear in the young larva in order that they may be fully formed in the pupa (Bauer [1904]; Pflugfelder [1937]), is apparently also associated with the way of life of the pupa.

Disintegration of the neuroblast proliferation centers takes place in the optic lobes of Oligoneoptera during pupal development. In the honey-bee, degeneration of the centers begins as early as the two-day pupa. On the first day only ganglionic mother cells and the large, unevenly dividing neuroblasts are subject to degeneration. The small neuroblasts continue to divide at this time. It is only towards the end of the succeeding (third) day that the degeneration process overtakes them also. The result of this is that in the five-day pupa there is not even a trace of neuroblast aggregations in the optic lobes.

3. The Deposition and Development of the Optic Centers

In the larva the optic centers arise as outgrowths of cells which have already been formed in the neuroblast proliferation centers during the embryonic period. It is customary to state that the larvae of insects with complete metamorphosis do not contain three ganglia in the optic lobes, like the adult insect, but only one (Pieris brassicae L., Hanström [1925]; Ephestia kuhniella Z., Schrader [1938]) or two ganglia (Culex pipiens L., Pflugfelder [1937]; many Trichoptera, Ehnbom [1948]).

However, the larvae studied by these authors possess simplified stemmata with a reduced number of retinal cells and therefore they cannot be considered normal for the Holometabola as a whole in regard to the larval structure of their optic centers. Some preliminary investigations which I carried out on the optic centers of larvae of some insects with complete metamorphosis showed that the degree of development of the larval optic centers is determined by the extent of development of their visual organs. When the latter are well developed (sawflies, campodeiform larvae of Neuroptera and beetles), all three ganglia are present in the optic lobes. When the stemmata are less developed (Lepidoptera larvae, eruciform larvae of beetles, etc.) the ganglion number is reduced to one or two. It is the third ganglion which first undergoes reduction in this case.

With regard to the development of the imaginal optic ganglia, their deposition, according to the authors who have worked on them, takes place very differently in different insects. According to Rösch [1913] differentiation of the optic centers in the Strepsiptera occurs within an integral ganglion and in such a manner that the first optic ganglion, then the second, and finally the third separate off from the original integral neuropile mass.

This process has been described somewhat differently by Hanström [1926] in Culex pipiens L., in which (according to Hanström) the larval eyes possess only one solitary ganglion (the " primary optic mass"). The first ganglion of the faceted eye arises from the growth of this larval ganglion. The second and third ganglia of the compound eyes form from the original united mass, which Hanström calls the "second primary optic mass".

Finally, an entirely different point of view on the deposition of the imaginal optic centers is held by Pflugfelder. In his first work (Pflugfelder [1936]), carried out on male Lecanium corni B., he came to the conclusion that the imaginal optic ganglia are laid down independently of the larval ones, with each one arising independently of the other ganglia. The views of this author underwent further development in his other paper [1937], which was devoted to testing Hanström's data regarding the development of the optic lobes in Culex pipiens L. Contrary to Hanström's work Pflugfelder found that in the mosquito the imaginal optic ganglia also develop independently of the larval ones and arise from three anlage which are separated from the very beginning. In this case the differentiation of the imaginal ganglia continues to the development of the compound eyes, consequently independently of them. Fairly rapid development sets in only with the differentiation of the compound eyes and then only in the first optic ganglion.

This difference of opinion induced me to investigate the laying down and the course of development of the optic lobes of holometabolous insects. The subjects of investigation were the honey-bee, in which the simplest form of this process was expected, and the sawfly Pristiphora pallipes Lep. in which preliminary observations had shown well-developed larval optic centers which could, evidently, complicate the process of formation of imaginal ganglia.

The development of the optic lobes in the honey-bee. The optic lobes are represented in the brain of newborn bee larvae by neuroblasts which form aggregations taking the form of the two nerve cell proliferation centers examined above. The first aggregation of neuroblasts invests the posterolateral part of the protocerebral lobe as a semicircle open in an anteromedial direction. The cells produced by this aggregation are sent forward and medially (Fig. 4, 1, pc I). The second aggregation of neuroblasts looks like a simple colony of cells near the posterolateral margin of the fibrous matter of the protocerebrum. It produces nerve cells in a medial direction (Fig. 4, 1, pc II).

The condition of the anteromedially open semicircle, which is formed by the first proliferation center in the newborn larva, is preserved through the following day. However, toward the third day the center orientation changes somewhat. At this time the brain becomes less bent forward and the semicircle of the proliferation center, together with the entire optic lobe, appears turned in such a manner that its open part becomes directed medially and the center itself lies in a plane parallel to the anterior surface of the head capsule (Fig. 4, 2, pc I).

During molting in the pupa there occurs, in connection with the lateral expansion of the brain, a further rotation in the plane of the semicircle of the proliferation center with the result that its open end is directed in a posteromedial direction (Fig. 4, 8, pc I). This position is maintained by the center during the whole of its subsequent existence.

In the first three or four days of larval life the second nerve cell proliferation center changes its position even more than the first center. Following the moving optic lobes, it begins to rotate its median edge posteriorly and laterally. This is helped by the arising third optic ganglion and proceeds to the extent that in the four-day-old larva it becomes rotated 130° in the horizontal plane in relation to its original position(Fig. 4, 1, 3 pc II).

Development of the first optic ganglion. The lamina ganglionaris first appears in the four-day-old larva as a small layer of neuropile which is close to the first proliferation center throughout its length, being somewhat proximally situated(Fig. 4, 3, I). At this time the ganglion is separated from the proliferation center by several layers of cells and measures barely 10 · 30 microns in section. The broadest surface of the ganglion is directed posteriorly and laterally. Externally to it is the body of nerve cells belonging to it. The latter are formed from the activity of the neuroblasts of the first proliferation center, which sends out developing cells not only forward and medially, but also backward(Fig. 4, 4; the direction in which cells emerge from the proliferation center is indicated by arrows). The particular cells issuing in the latter direction are the ones which also form the layer of outer nerve cells of the lamina ganglionaris.

The dimensions of the first optic ganglion cited above remain constant throughout the entire larval period. In the prepupa, however, the width of the ganglion greatly increases and its section increases to 20 · 140 microns. In the prepupa, the position of the ganglion remains the same, bending, however, slightly to the side(Fig. 4, 7, I).

During molting, the pupa undergoes a very great increase in the volume of the head capsule. In the worker bees, the width of the head increases from 2.24 mm before the molt to 3.88 mm after, meaning an enlargement of approximately 73%. The brain also takes part in this movement, being extended laterally by the postretinal fibers. However, it does not increase in width so much, growing only 30.4% in relation to its width before the molt. As a result of this extension, a change takes place in the position of the optic lobes as a whole. As regards the first optic ganglion itself, it moves somewhat forward and laterally and appears in horizontal sections to be very strongly bent out in the direction of the compound eye rudiment. The impression is created that the lamina ganglionaris, especially its median part in transverse section, is drawn into the movement of the eye rudiments when the head cuticle is straightened out during molting(Fig. 4, 8, I).

As previously indicated, the growth in sectional area of the first ganglion is extremely moderate during the larval period. Acceleration in growth coincides with the time of prepupal formation, when the lamina grows intensively in width. From the last larval day to the first prepupal day its width increases by almost 300%.

During molting, the pupa again undergoes increased growth, after which it once more slows down. In the third and fourth day of the pupal stage there is another spurt of lateral growth in the lamina. In the four-day-old pupa it achieves the maximum width of the entire growth period, reaching almost 280 microns(Fig. 4, 9, I). During the whole preceding time, growth in thickness proceeds without any noticeable fluctuation.

The most interesting phenomena occur from the fourth to the sixth day of the pupal period. At this time the width of the lamina becomes reduced by almost 130 microns, that is, 46%. Simultaneously the lamina grows strongly in thickness. The speed of growth of the lamina in this direction is more than three times greater than it was during the preceding two days. Finally, during the remaining four days to adult emergence, growth in width of the lamina continues, but not at such a rate. Its width during this time almost does not increase (Fig.4,3-11,I).

The process of formation of the imaginal structure of the first optic ganglion also breaks down into a series of phases, which are partly related to its step-like growth. First of all the lamina ganglionaris growth period is clearly distinguished and continues from the moment of its deposition during the fourth day of the larval phase to the third day of the pupal one, inclusive. The most characteristic feature of the structure of the first optic ganglion during this period is its division into one newly arisen and one older part. In relation to the fact that the nerve cells of the lamina ganglionaris produce the first proliferation center, the oldest part of the lamina is that which is most distant from the center.

In this older part(Fig. 5, a), between the brain membrane and the ganglion neuropile, there are three or four layers of nerve cells (nc) while at the very margin of the fibrous mass there is a layer of neuroglial cells (ng). The neuropile itself is rather diffuse and is traversed by the strands of nerve cells from the outer ganglion layer and the postretinal fibers (no). In the actual fibrous matter solitary neuroglial cells are only rarely encountered.

The younger part of the lamina differs from the older in that its layer of nerve cells and layer of neuroglial cells are denser, while its fibrous matter is more delicate. The bundles of transverse fibers cross the younger region more frequently, making its neuropile seem more compact.

At the beginning of the pupal period a diffusion of the neuropile occurs between the bundles of fibers and there is an immigration into the newly forming band of neuroglial cells. On the strength of this the integral layer of these at the distal surface of the ganglion neuropile ceases to exist. Some of the neuroglial cells dis-

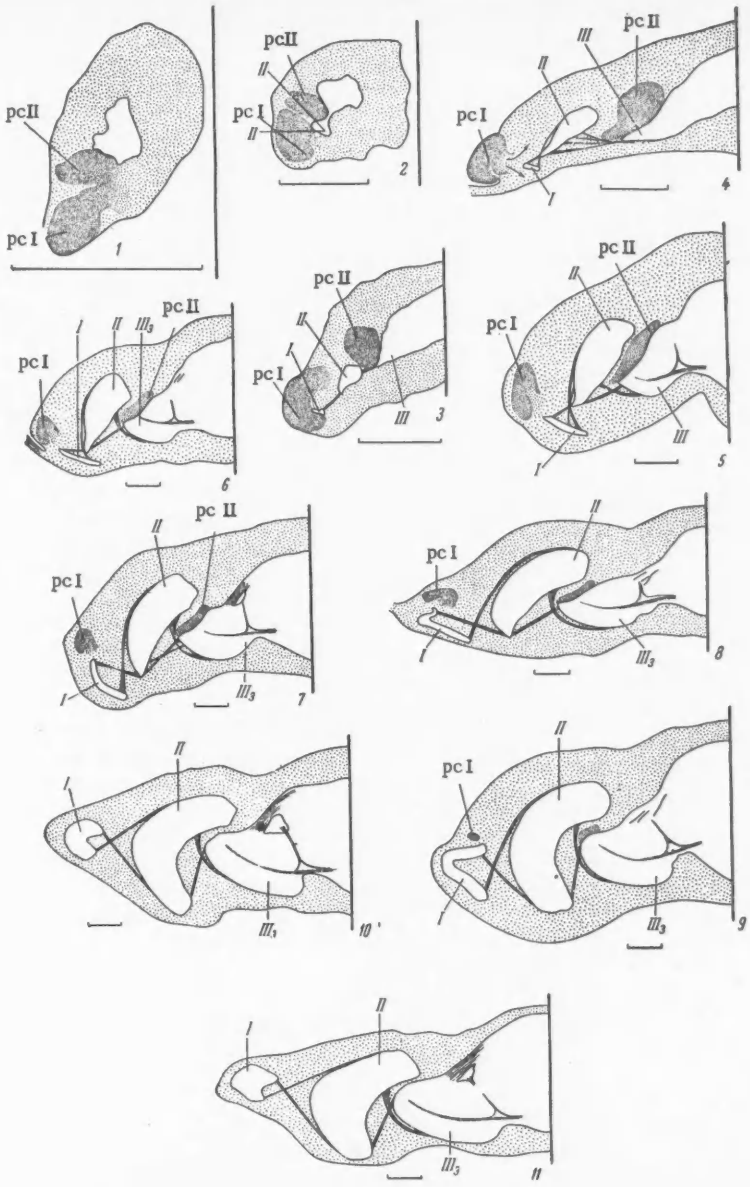

Fig. 4. Structure of the optic lobes of Apis mellifica L. in successive stages of larval and pupal development (diagrams of horizontal sections). 1) Newborn larva; 2) three-day larva; 3) four-day larva; 4) six-day larva; 5) one-day prepupa; 6) two-day prepupa; 7) three-day prepupa; 8) one-day pupa; 9) four-day pupa; 10) six-day pupa; 11) nine-day pupa. pcI) First proliferation center of optic lobe nerve cells; pcII) second proliferation center. Remaining abbreviations as in Fig. 1. Scales near diagrams equal 100 microns.

tribute themselves between the bundles of fibers throughout the entire depth of the neuropile, while others become arranged in a layer at the edge of the outer chiasma (Fig. 5, b).

The beginning of the second stage in the formation of the definitive structure of the first optic ganglion coincides with the time of its reduction in width and great increase in thickness. From the fourth to the fifth day of the pupa a swelling and approximation of the fiber bundles takes place which probably also results in the reduction of the width of the lamina. The spaces between the fiber bundles disappear and the neuroglial cells become literally squeezed between the fibers, which greatly elongate (Fig. 5, c).

In the remaining days of the pupal period the ganglion structure practically does not change. During this time the fibers composing the bundles become greatly thickened, as result of which all that remains distinct is the neuroommatidial structure of the neuropile of the first optic ganglion.

Development of the second optic ganglion. The second optic ganglion is the first of the three composing the optic lobe to be seen. It has already appeared in the three-day larva as an amorphous mass of neuropile tissue connected by a slender strand of fibers with a small projection of the protocerebral lobe (Fig. 4, 2, II).

On the following (fourth) day of larval development the ganglion develops so fast that on the fifth day it has acquired a shape somewhat reminiscent of that in the adult brain (Fig. 4, 4, II). At this time it is connected via the inner chiasma with the third optic ganglion and via two bundles of fibers directly to the protocerebral lobe. A transverse section of the ganglion, which most clearly demonstrates the process of its formation, has a cuneiform shape. The acute margin, directed posteriorly and laterally, is prolonged into fibers of the outer chiasma, while from the posteromedial surface, fibers of the inner chiasma emerge.

All nerve cells belonging to the second optic ganglion may be divided into two major groups on the basis of the course followed by their fibers. The first group includes the cells, the extensions of which penetrate the ganglion from the side of the palisade layer and form a transverse striation in the neuropile. These cells surround the anterolateral, superior, and inferior surfaces of the ganglion in a dense layer. Similar cells, although fewer in number, are arranged along the posteromedial surface as well (Fig. 1, II $nc_{1,2}$). All these cells arise as the result of the activity of the first proliferation center in the optic lobes (Fig. 4, 4, pc I). The oldest part of the ganglion is evidently the central anteromedial zone of its neuropile. The overlaying of the ganglion neuropile takes place from its superior, posterolateral, and inferior margins.

The neurones giving rise to the extensions which form the longitudinal fibers of the second ganglion make up the second group of cells. They are situated somewhat medially to the anterior inner edge of the ganglion and are distinguished from the cells of the outer ganglionic layer by their larger size, the abundance of their cytoplasm, and the large spherical nuclei (Fig. 1, II nc_3). In the prepupal period some solitary neuroblasts may be observed among these cells, actively dividing right up to the second pupal day. The newly arising cells are sent off in the direction of the second optic ganglion. We may suppose that the cells making up the direct con-

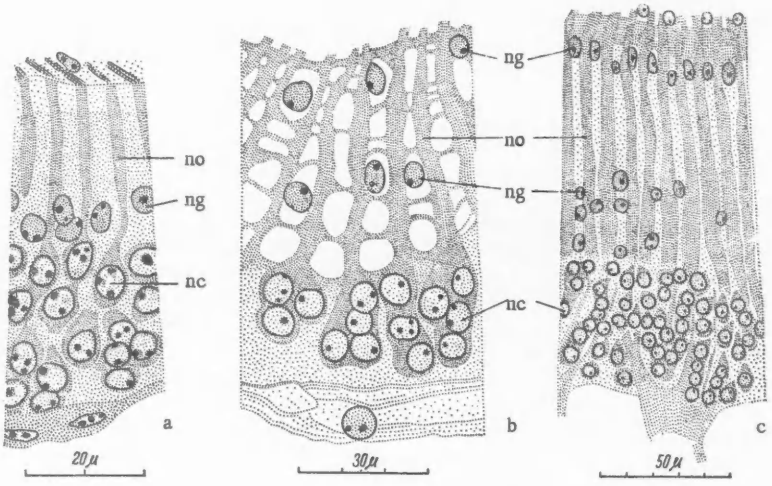

Fig. 5. Structure of the first optic ganglion of Apis mellifica L. in the prepupa (a), four-day (b) and six-day (c) pupa. nc) Nerve cells of the first optic ganglion; ng) neuroglial cells; no) neuro-ommatidium.

nection between the second optic ganglion and the protocerebral lobe arise from another source than that of the rest of the ganglionic cells, namely as a result of the division of the solitary neuroblasts. This opinion corresponds fairly well with the observations of Heimons already presented, according to which solitary neuroblasts may also enter into the composition of the first protocerebral lobe during its formation in the embryo.

The same growth periods as those of the ganglionic plate are observed in the second optic ganglion. For instance, one may observe an acceleration in lateral growth during molting to the pupa and from the third to the fourth pupal day. In the subsequent period a reduction in the width of the ganglion occurs. All these changes are, however, less distinct than in the first optic ganglion.

As a consequence of the fact that the neuropile of the second ganglion is continuously built up from the side, two gradually merging, structurally different, zones enter into the composition of the ganglion during the entire activity period of the first neuroblast accumulation. The first of these, occupying the anteromedial area of the ganglion neuropile, appears at the very beginning of its formation and is therefore ontogenetically the oldest. As early as the prepupa this zone consists of the same three main layers of fibrous matter which are observed in the imago. The distal and proximal palisade layers and the middle layer of longitudinal fibers between them may be distinctly made out. In the young pupa the three main layers are differentiated into more second-order layers, which may number up to eleven.

The neuropile of the youngest part of the ganglion is of much simpler composition. It includes only the outer palisade layer, and this is represented only by one of its three sublayers. The median layer of longitudinal fibers and the proximal palisade layer are apparently built up more slowly and are consequently absent at the young edge of the ganglion.

The difference in structure between the old and young parts is retained to the end of the activity of the first proliferation center of optic lobe cells, until termination of ganglion growth, which occurs through the assimilation of outgrowths of new cells into its neuropile. Growth of the ganglion, however, does not cease then. This is shown by an increase in volume of 80% in the last five days of the pupal period. Simultaneously a compacting of the neuropile takes place, the palisade structure becomes less distinct, and the subdivision of the layers disappears.

Neuroglial cells are absent in the neuropile of the second ganglion throughout almost the entire pupal development period. Only towards the end of the latter do they begin to grow into the neuropile from the side where the longitudinal fibers of the median layer enter. There are considerably fewer neuroglial cells penetrating the neuropile from the side of the palisade layer.

Developing of the third optic ganglion. The moment of deposition of the third optic ganglion is much more difficult to catch than it was in the first two ganglia because it does not develop as an independent neuropile mass but develops in close contact with the fibrous matter of the protocerebral lobe. In the three-day larva, when the second optic ganglion can first be made out, the latter is connected by a bundle of fibers with a small projection of the protocerebral lobe (Fig. 4, 2). It is, however, difficult to say whether this projection can be considered to be the third ganglion or not. In any case, its distinct isolation from the rest of the fibrous mass cannot be seen.

One may refer to the medulla interna with complete reliability starting with the fourth day of larval development, when the ganglion already appears well developed (Fig. 4, 3, III). During the remaining days of the larval period the third optic ganglion changes slightly in form and in its internal structure. In the full grown larva it looks like a gradually tapering lateral projection of the protocerebral lobe, the neuropile of which gradually merges into the neuropile of the latter (Fig. 4, 4, III). The limits between these two sections may be distinguished only with the help of the bundles of fibers penetrating the ganglion neuropile from the front. In the adult brain this bundle runs exactly along the boundary of the third optic ganglion with the protocerebral lobe. This bundle divides inside the neuropile, sending some fibers into the protocerebral lobe and some into the layer of longitudinal fibers in the third ganglion. Thus, by means of this bundle the palisade layer may be discerned even in the early stages of the development of the medulla interna (Fig. 4, 5-11, III-).

The palisade layer of the third ganglion is the one which is connected with the palisade layer of the second optic ganglion via the inner chiasma. This means that in order to compare the growth of the medulla interna with that of the other two ganglia, it is necessary to compare the extent of its palisade layer. The latter elongates very slowly at the end of the larval and the beginning of the prepupal periods. During molting to the pupa, extensive growth in the length of the palisade tissue takes place. In only one day after molting the layer grows to the same extent that it did after three days in the prepupa. Immediately after this on the second and third days of the pupal period the layer shortens somewhat, and then during the subsequent three days it once again extends quickly. In the remaining four pupal days the speed of growth of the palisade layer falls; this is evidently related to the termination of activity in the second aggregation of neuroblasts in the optic lobes.

The growth in thickness of the palisade layer proceeds quite differently. Being very thin in the six-day larva, it thickens considerably towards the second day of the prepupa and grows very slowly in after this.

remaining at practically the same thickness during the whole period of pupal development. This course of growth in the thickness of the palisade layer is most probably related to the way in which its structure is formed. During the larval period the neuropile of the ganglion remains homogeneous and is traversed by only a few fiber bundles. There is no trace of palisade structure. Only at the acute lateral margin is a section of more compact fibrous matter visible. By the two-day-old prepupa stage one observes the appearance of stratification and a palisade structure similar to that of the proximal layer of the second ganglion. Subsequently no visible changes in structure take place, and only in the full-grown pupa can one observe a general compacting of the neuropile.

Thus the palisade layer, arising originally as a homogeneous neuropile of slight thickness, achieves by the end of the prepupal period its final thickness and thus takes on its characteristic structure. Growth in the older parts of the ganglion is not observed after this.

Growth in the palisade layer takes place by means of an overlaying of new portions of neuropile from the side which borders the second nerve cell proliferation center. The structure of the newly formed part of the palisade layer differs from that of the older sections in the less evident complexity of its structure, that is, in the same way that the corresponding sections of the second optic ganglion differ from each other.

Nerve cells in the third optic ganglion may be divided into cells of the palisade layer and cells of the longitudinal fibers. The most extensive is the group of cells of the palisade layer, which arises from the activity of the second neuroblast proliferation center and which surrounds the third ganglion from above, the sides, and below (Fig. 1 IIInc$_3$). The cells of this group are very small, rather equal in size, and similar to the nerve cells of the outer layer of the second optic ganglion.

The longitudinal fibers of the third optic ganglion have a three-fold origin. One of the bundles of longitudinal fibers apparently arises from outgrowths of the small cells situated below and behind the third ganglion near the point of its transition to the protocerebral lobe. The median fine bundle of fibers is formed from outgrowths of the large cells lying in front of the ganglion (Fig. 1, IIInc$_1$). These cells are separable on the basis of their size as early as the prepupa. They are rich in cytoplasm and have large spherical nuclei. The outer appearance of these cells is so different from the cells of the palisade layer, known to form as a result of the activity of the second neuroblast aggregation, that one can scarcely suppose that they originate from the same source. However, solitary neuroblasts could not be discovered among the large cells examined.

In my preparations it was not possible to identify with sufficient accuracy the cells which by their extensions give rise to the third, upper bundle of longitudinal fibers. One should, however, point out that behind and somewhat medial to the third optic ganglion, at the level of the upper bundle, there are some large nerve cells similar to those which formed the fibers of the median bundle (Fig. 1, IIInc$_2$). Even in the prepupa many dividing solitary neuroblasts may be found among them.

The development of the imaginal optic centers in the sawfly Pristiphora pallipes Lep. is complicated in comparison with that of the bee, as discussed previously, by the fact that in the sawfly the larva already has well-developed optic ganglia which are present in full complement, that is, which are three in number (Fig. 6, 1, I 1, II 1, III 1) The ganglia are made of compact homogeneous neuropile which stains strongly in iron haematoxylin. Both chiasmata are present.

However, even in the larval stage, before the beginning of cocoon spinning, a considerable change in the structure of the lobes takes place (Fig. 6, 2). The second optic ganglion ceases to be fabiform in horizontal sections through the brain. Its posterolateral margin forms a process which is composed of lightly staining fibrous matter (III). A similar process appears at the lateral edge of the third optic ganglion, which therefore becomes more attenuated (IIII). The newly formed portions are united by a bundle of fibers.

At the succeeding stage of development, represented in Fig. 6, 3, the changes described have already gone forward considerably. An appendage of light-colored neuropile has also appeared at the anterior edge of the first optic ganglion of the larva (II). The number of fiber bundles connecting the newly formed parts of the ganglia has increased. Their chiasmata are already distinctly visible. Subsequently growth of the new parts of the ganglia does not cease. Their neuropile acquires a structure which is similar to that described for the ganglia of young bee pupae.

Simultaneously with the growth of the new portions of the fibrous matter there occurs a disintegration of the old parts of the ganglia which used to be the larval optic centers. Their neuropile becomes diffuse and reduced in volume until, finally, it disappears completely (Fig. 6, 3–5). Many pycnotic nuclei are observed at this time among the cells belonging to the larval centers.

As a result of the processes described above, not a trace remains of the larval centers by the time of the young pupa. These have been replaced by the imaginal optic centers, which are considerably more strongly developed than the larval ones.

* * *

When the observations described above are compared with the data obtained by other authors, it becomes evident that the data on the development of the optic lobes in bees does not in any way agree with the notion that the development of the imaginal centers occurs from an initially integral mass, as described for the Strepsiptera by Rösch. Similarly my observations do not support those of Hanström on the simultaneous deposition of the second

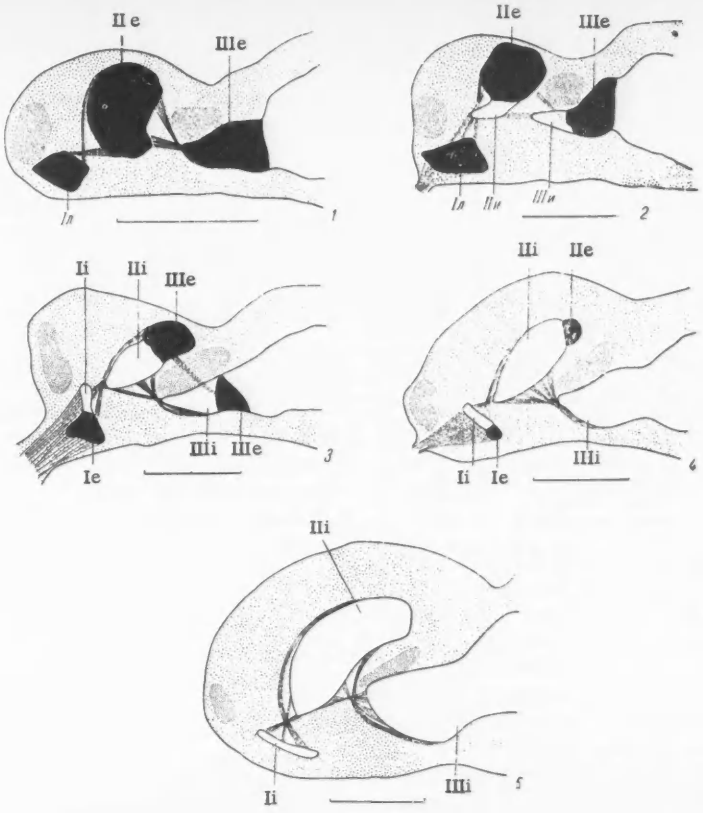

Fig. 6. Diagram of the development of the imaginal optic lobes in Pristiphora pallipes Lep. 1) Optic lobe of a full-grown feeding larva; 2) optic lobe of a last-instar larva before cocoon formation; 3, 4, 5) successive stages of change in the structure of the optic lobes of the prepupa in the cocoon. I l, II l, III l) Larval ganglia; I i, II i, III i) imaginal ganglia. Scales by diagrams equal 100 microns.

and third optic ganglia. On the other hand, the opinion of this author that the first imaginal optic ganglion develops from the spread of the first larval ganglion is close to the truth, to the extent that the observed formation of the first optic ganglion in Pristiphora as an extension of the corresponding larval ganglion may be interpreted, to a certain extent, as growth of the latter. Degeneration of the larval part, if it takes place, is not easy to see because of the occasional very small size of the larval ganglion.

My observations agree most fully with the results obtained by Pflugfelder when he examined the development of the optic centers in Culex and some Rhynchota, since in these all three optic ganglia arise as independent aggregations of neuropile and develop largely independently of the development of the compound eyes.

Pflugfelder's allegation that the larval and imaginal centers arise independently of each other (Pflugfelder [1936]) could have given rise to some difference of opinion, since I found that in Pristiphora the imaginal centers develop as extensions of the corresponding larval ganglia. However, in a letter kindly sent by Pflugfelder he explained that independence in this case must be understood in the sense that the imaginal ganglia do not arise from the larval, but rather from rudiments common to both (neuroblast aggregations). In this form my point of view on the relationship between larval and imaginal ganglia obviously conforms completely with that of Pflugfelder.

In conclusion, one may apparently describe the different types of development of the imaginal optic centers in the following manner. In most of the Polyneoptera there is a direct development of the optic centers, beginning in the embryonic period and continuing throughout the entire preimaginal period of postembryonic development (Fig. 7, Gryllus). In the aphids there is a differentiation of the larval three-faceted eyes which are preserved together with the compound eyes in the adult

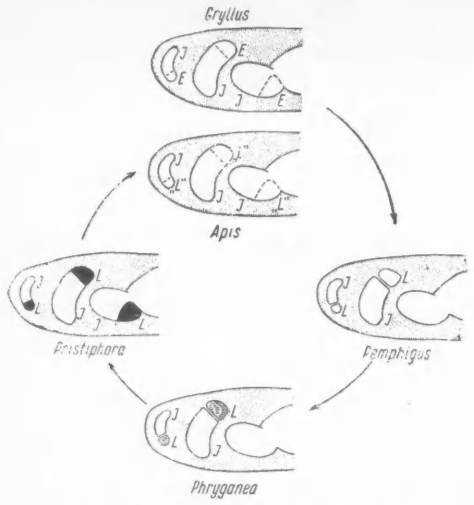

Fig. 7. Relationship in the development of the imaginal optic ganglia in various insects. E) sections of ganglia developing during the embryonic period; L) ganglia corresponding to the larval eyes; „ L") sections of ganglia developing in the larval stage but corresponding to the adult eyes; J) sections of eyes developing in the Holometabola during metamorphosis and in the Hemimetabola during the nymphal period. The striated ganglia are preserved in the imago, but do not have a corresponding receptory apparatus; the shaded sections are present in the larva and degenerate at the time of metamorphosis.

insects. There is a corresponding formation of the larval optic centers, which are preserved in the imago as well (Pflugfelder [1936, 1937]) (Fig. 7, Pemphigus).

Development of larval eyes also takes place in the majority of Oligoneoptera. Larval optic centers are correspondingly also formed. Thus in some Trichoptera (Ehnbom [1948]), in spite of the reduction in the larval eyes that takes place at metamorphosis, the larval centers are preserved even in the imago (Fig. 7, Phryganea). In the rest of the Oligoneoptera studied so far, as was demonstrated in the sawfly, the larval centers degenerate in the prepupal period simultaneously with the reduction in the stemmata and are replaced by the imaginal centers (Fig. 7, Pristiphora). Finally, in the blind larvae of Oligoneoptera the larval optic centers are not laid down. In this case there is a reversion to the type of development of imaginal optic centers which we saw in Polyneoptera (Fig. 7, Apis). However, the time of their deposition is moved up from the embryonic to the postembryonic period.

SUMMARY

In this work the activity of the neuroblasts of the optic lobes and the formation of the imaginal optic ganglia in some Pterygota have been studied.

Newborn larvae of the honey-bee (Apis mellifica L.) have no optic centers. Their optic lobes consist of two developmental foci, composed of two kinds of neuroblasts and ganglion mother cells. The smaller neuroblasts divide evenly and form two daughter neuroblasts. The larger neuroblasts divide unevenly and produce a large daughter neuroblast and a ganglion mother cell. The latter divides evenly to form two cells which become differentiated into neurons. The same processes of neuron formation take place also in Pieris brassicae L. and Aeschna sp.

In the formation of the ganglion mother-cells in Tettigonia viridissima L. and Siphlonurus sp.; on the other hand, the neuroblasts divide evenly.

The development of the imaginal optic ganglia is simplest in those Oligoneoptera in which the larvae possess no stemmata. In these cases (e.g., in Apis mellifica) the first and second imaginal optic ganglia arise as separate fibrillar masses and the third optic ganglion originates as a lateral outgrowth of the protocerebral lobe.

In the sawfly Pristiphora pallipes L. the larva has three well-developed optic ganglia. The imaginal optic ganglia arise as developments of the corresponding larval ganglia. During the prepupa the imaginal sections of the ganglia continue to grow, while the larval sections degenerate. At the same time the nerve cells belonging to the larval ganglia also die off.

Finally, a scheme of the developmental relationships of the optic ganglia in insects differing in this respect is proposed.

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THE MUSCLES OF THE MOUTH PARTS AND PHARYNGEAL REGION IN TENEBRIONIDAE (COLEOPTERA) OF TURKMENIA

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In the study of the musculature of the mouth parts and pharynx in certain Tenebrionidae of Turkmenia there arose the problem of determining the principal types among the desert forms and of examining the significance of these types for understanding the phylogenetic relationships. The question is quite important in appraising the distribution of the "origins" of the muscles of the head capsule as a criterion of the homology of the endoskeletal parts.

Snodgrass [1947] shows that on the frontal parts of the head capsule two groups of precerebral muscles are attached, separated at the pharynx by the frontal ganglion and its pharyngeal commissures. The muscles attached in front of the frontal ganglion arise on the clypeus. Muscles arising on the frons are attached to the pharynx behind the frontal ganglion and also muscles running to the hypopharynx and labrum.

Du Porte [1946] doubted the value of the origins of muscles in determining the boundaries of the exoskeletal parts. Both points of view can be considered after an examination of the structural features of the musculature of the mouth parts in various representatives of the Tenebrionidae.

A large amount of literature has been devoted to the study of the head musculature of insects, especially to that of the mouth parts. It is to be regretted that only in very recent times have any attempts been made to work out a comprehensive terminology for the musculature of insects. Keler [1955], in particular, has determine the synonomy in the nomenclature employed by certain well-known authors (Burmeister, Voss, Berlese, Bauer, Snodgrass), for muscles, and has proposed his own terminology. The latter is quite acceptable in so far as the names given to the muscles define the points of attachment and the place of origin, but not the function, which, on the whole, is more variable. In the present work the topographical terminology of Keler is adopted. The Russian terminology for the muscles is, to a considerable degree, based on the topographical principle.

In the course of the work the musculature of the mouth parts of Pimelia cephalotes Pall. was studied in detail. In many other forms only a few groups of muscles were examined.

7.* Labral muscle of the epipharynx (Musculus labroepipharyngalis). The origins of both muscle bundles are located on the basal part of the dorsal wall of the labrum. In Pimeliini the lines of attachment for the muscular fibres originate on the epipharynx behind the basal edge of the lip, somewhat medial to the tormae and, running forwards, reach as far as the central sensitive area of the epipharynx. On the whole, the lines of attachment of both bundles have the form of a discontinuous arch in the middle. In Blaptini the internal branches of the tormae push aside the line of attachment of both bundles forwards and inwards so that it is completely in front of the basal edge of the lip. The contraction of the muscles causes a depression of the epipharynx.

9. Frontal muscle of epipharynx (M. frontoepipharyngalis). (Figs. 1,2, 4,9—12). The relative dimensions of this muscle fluctuate greatly in the various species depending on the function and structure of the labrum. In the forms having a large, mobile labrum both muscle bundles are of larger magnitude and their origins are situated on the hind part of the frons behind the brain (Pimeliini, Platyopini, Zophosini, Adesmini, Blaptini, Akidini). Parallel with the limitation in the mobility of the labrum, the reduction in its dimensions and its displacement under the clypeus, a shortening and a tapering of the bundles take place in some tenebrionids. Thus, in Lachnogyini, Leptodini (Fig. 10), Stenosini, Platamodini and Diaperini the origins of the bundles are situated in front of the brain which, because of this, is quite visible from above when the dense sheaths are removed. The separate stages in the reduction of the muscles can be traced back in the Tentyriini. Here, as a rule, they are thin but often also shortened (Alcinoë).

The tendinous endings of the bundles of muscles under inspection are always attached to the epipharyngeal arms connected with the basal corners of the labrum. The simultaneous contraction of both bundles pulls the labrum in under the clypeus. Unilateral movement of the lip is also possible if one of the bundles contracts.

11. Internal cranial muscle of the mandible (M. craniomandibularis internus) (Fig. 2, 9—11) attains an exceptional size; the body of the muscle occupies a

* In the text the number given to the muscle is according to Keler [1955]; the number of the muscle enters into its name.

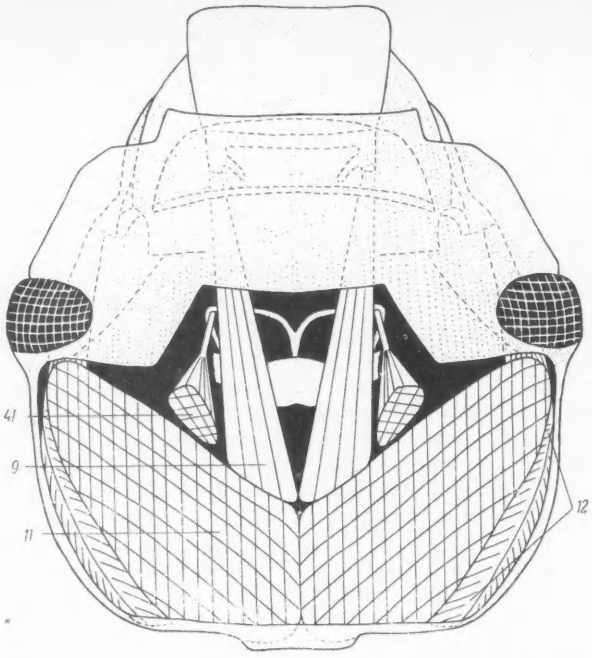

Fig. 1. Arrangement of the Muscles in the Head of Pimelia cephalotes Pall. (muscles of the pharynx not shown); view from above.

considerable portion of the head capsule. The origin of the external cranial muscle divides the topographic origin of the muscle into two parts of approximately equal size : the vertex portion (pars verticalis) and the genal (pars genalis). The origin of the pars verticalis occupies the vertex and occipital regions of the head capsule and extends forwards to the posterior edge of the eyes. Posteriorly the muscle fiber extend as far as the edge of the occipital foramen which happens also in those cases where the occipital part of the head capsule is elongated (Erodiini; Weisea from Opatrini). The origin of the pars genalis at the lower edge adjoins the origin of the external cranial muscle of the cardo.

The fibers of both portions of the muscle terminate in the powerful tendinous apodeme freely articulated with the internal basal corner of the mandible.

12. External cranial muscle of the mandible (M. craniomandibularis externus) (Figs 2, 9, 11) is considerably weaker than the preceding muscle and appears to be its antagonist. In the majority of forms, the origin of the muscle in the form of a narrow band stretches from the posterior edge of the eyes as far as the occipital foramen, almost completely dividing the origin of the internal cranial muscle of the mandible into two parts, as already mentioned. At its upper edge the origin of the muscle, as a rule, reaches the region of the attachment of M. praephragmapostoccipitalis medialis but never exceeds this limit. In representatives of the genera Diaphanidus, Ammozoum, Arthrodosis and Weisea, in spite of the elongation of the occipital part of the head capsule, the anterior boundary of the attachment of the fibres of M. praephr. med. stops at the original level of the comparatively compound eyes, being now considerably removed from the edge of the occipital foramen. In consequence of this the upper edge of the external cranial muscle in these forms appears to be moved forwards far from the edge of the occipital foramen. In Leptodini and Stenosini (Reitterella, Dichillus) the elongation of the capsule behind the eyes is not accompanied by a shift of the upper edge of the M. craniomandibularis internus from the edge of the occipital foramen, since the region of attachment of M. praephr. med. in these tenebrionids is small.

The flagellate-shaped apodeme to which the short fibers of the muscle in question are attached is articulated to the external basal edge of the mandible either in a line with the condyle (Pimeliini, Platyopini, Akidini, Epitragini, Tentyriini, Adesmini, Erodiini, Lachnogyini, Leptodini, Stenosini, Helopini, etc;), or in the middle part (Blaptini, Opatrini, Pedinini, besides the genus Dandarus, and a few Tenebrionini).

The maxillae, distinguished by their strong differentiation and diversity of movement, possess an intricately constructed internal and external musculature. The external musculature arises in the head capsule and actuates the whole jaw, the interior is completely enclosed in the mouth appendages and carries out the movements of its separate sclerites relative to one another.

15. External cranial muscle of the cardo (M. craniocardinalis externus) (Fig. 5) arises on the gena between the base of the posterior arm of the tentorium and the lower edge of the origin of the genal part of the internal cranial muscle of the mandible. In relation to the shape of the head capsule the posterior edge of the origin of the muscle may be turned obliquely outwards (Pimeliini, Blaptini), straight back (Weisea) or obliquely inwards (Adesmini, Erodiini). The long tendon is attached to the inner end of the cardial apophysis.

17. Tentorial muscle of the cardo (M. tentoriocardinalis) (Fig. 5) arises on the external surface of the posterior and anterior arms of the tentorium. In the upper part the muscle of each maxilla is divided into two bundles, one of which is attached to the interior corner of the cardial apophysis and the other in a line with it, but a little to the side and higher. In Tagona macrophthalma Fisch.—W. the muscle fibers, at a considerable distance, divide into two bundles and cause the tendons of the latter to be inserted far from one another.

18. Tentorial muscle of the stipes (M. tentoriostipitalis) (Fig. 5) arises on the anterior surface of the anterior, and partly the posterior, arms of the tentorium; the end of this strong muscle is inserted in the recess situated on the inner edge of the subgalea.

The function of the external muscles of the maxillae is as follows: the outer cranial muscle of the cardo abducts the maxilla when it contracts; the tentorial muscle of the cardo, elevating the cardo a little, moves the maxilla outwards; lastly, the tentorial muscle of the stipes on contraction adducts the maxilla, dropping it downwards.

20. Stipital muscle of the lacinia (M. stipitolacinalis) (Fig. 3) arises on the collar running lengthwise along the basal edge of the stipes. The muscle is inserted on the basal edge of the lacinia, which it actuates.

21. Stipital muscle of the galea (M. stipitogalealis) (Fig. 3) at its origin occupies a large portion of the inner surface of the stipes and subgalea. The tip of the muscle

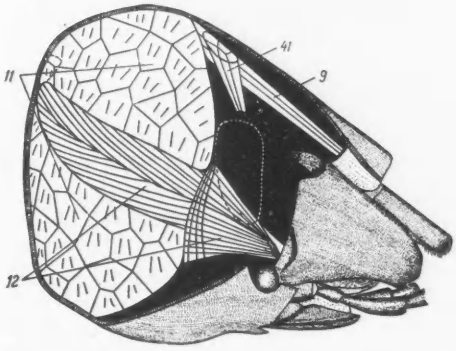

Fig. 2. Arrangement of the Origins of the Cranial Muscles of the Mandible in the Head of Pimelia cephalotes Pall., lateral view.

Fig. 3. External Musculature of the Maxillae of Pimelia cephalotes Pall. (without M. palpopalpalis maxillae primus), view from below.

is attached to the upper part of the basal edge of the basigalea. Judging from the place of insertion it seems that the muscle, operating through the basigalea, raises the galea a little.

Close to the inner edge of the subgalea in Tenebrionidae a small muscle bundle arises and runs between the stipital muscles of the lacinia and galea to the inner edge of the palpifer. Since the palpifer, according to its origin, appears to be the first joint of the palp one might think that, in the given instance, the internal stipital muscle of the maxillary palp is being discussed (M. stipitopalpalis internus—23) (Fig. 3). The antagonist of this muscle is absent.

24. Primary muscle of the maxillary palp (M. palpopalpalis maxillae primus) has its origin on the dorsal wall of the palpifer and the short tendon is attached to the outer basal edge of the first joint of the palp. Through the first joint this strong muscle moves the whole palp.

In the first joint of the palp the muscle is absent. On the outer wall of the second and third joints of the palp the origins of the third and fourth muscles of the maxillary palp are situated (m. palpopalpalis tertius 26 and quartus 27) (Fig. 3). The tip of the first of these muscles is attached to the basal wall of the third joint, the tip of the second to the basal edge of the fourth joint. Both muscles appear to be flexors of the joints to which they are attached.

28. Submental muscle of the prementum (M. submentopraementalis) (Figs. 6-8) originates on the anterior surface of the ridge situated close to the anterior edge of the submentum. Running between the dorsal apophyses of the mentum the muscle fibres are inserted on the basal

edge of the prementum. In the overwhelming mejority of tenebrionids (Helopini, Tenebrionini, Cossyphini, Diaperini, Opatrini, Pedinini, Platyscelini, Lachnogyini, Leptodini, Stenosini, Platamodini, Akidini, Pimeliini, Platyopini, Epitragini, Tentyriini, Zophosini, Erodiini, Adesmini) the muscles are fan-shaped with an undivided tip inserted in the middle of the base of the prementum. Only in Blaptini do the muscles consist of two large or smaller individual bundles. In Blaps titanus Men., in particular, the two bundles are inserted at a considerable distance from one another. In Blaps scutellata Fisch.-W. the bundles are similarly separated but their tips are much nearer the middle of the base of the prementum. The paired structure of the submental muscles of the prementum appears to be a feature which, on the whole, is more frequently met with in the coleopterous larva then in the imago (Dorsey, 1943, Figs. 49, 66, 72, 98 , 122). Naturally, it is also representative of such geologically old orders as Blattodea (loc. cit. Fig. 3). It is possible that this character is of secondary origin in Blaptini. However, a certain tendency to fusion appears already in isolated genera of Blaptini. In Prosodes solskyi Faust., Dila seriata Rtt., Blaps lethifera March., B. rugosa Gebl. the wide muscle bundles are so close to one another throughout their whole length (excluding the very tip)

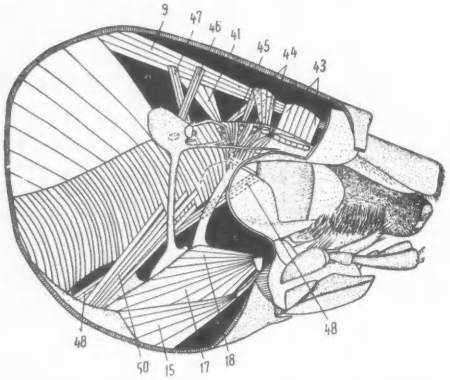

Fig. 4. Arrangement of the Muscles in the Head of Pimelia cephalotes Pall. (right mandible and its muscle removed), lateral view.

that their boundaries can be traced only with difficulty. It is characteristic that the representatives of the North American tribe Eleodini (Eleodes dentipes Eschsch.) which, genetically, are the nearest to Blaptini and do not differ essentially in the structure of their mouth parts from their Palearctic relatives, have completely lost the paired arrangement of M. submentopraementalis.

30. Upper tentorial muscles of the prementum (M. tentoriopraementalis superior) (Fig. 5) consist of two long bundles, the fibers of which arise on the internal surface of the posterior arm of the tentorium below the base of M. tentoriostipitalis. Running under the pharyngeal sclerite, the bundles fuse and are attached by a short ligament to the dorsal wall of the labium at the boundary of the hypopharynx. Together with the M. submentopraementalis the muscle appear to be a retractor of the prementum.

34. External premental muscle of the labial palp (M. praementopalpalis externus) (Fig. 6) arises on the internal surface of the basal apophysis of the prementum. Its

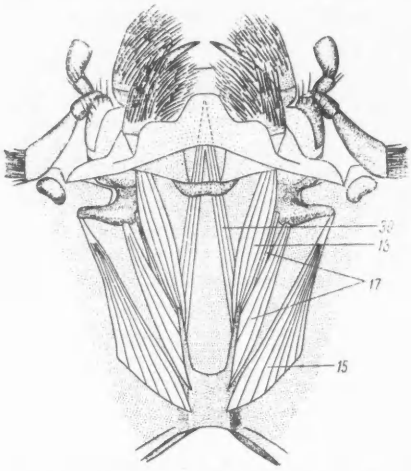

Fig. 5. Muscles of the Bottom of the Head capsule of Pachyscelis pygmaea Men., view from above.

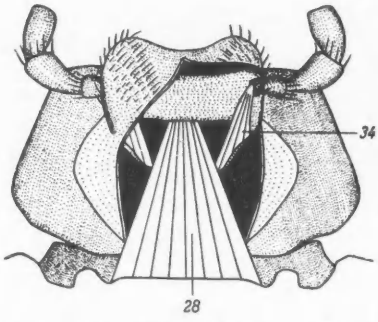

Fig. 6. Labial Muscles of Pimelia cephalotes Pall. (without the upper tentorial muscle of the prementum), view from above.

upper muscle is inserted on the outer basal edge of the first joint of the palp of which it appears to be the abductor.

41. Frontal muscle of the hypopharynx (M. frontohypopharyngalis (Figs. 1, 2, 4, 9-12) is of great interest in connection with the peculiarities in the arrangement relative to the bundles of M. frontoepipharyngalis. Both muscle bundles in question pass into long ligaments. The latter, being completely fused with the lateral walls of the pharynx, run in front of and below the angle of the

mouth. The commissure of the frontal ganglion running to the tritocerebrum always bends round in front of the ligaments of both muscle bundles which indicates that the muscles belong to the postoral group of stomadeal muscles.

The origin of the muscle may occupy various positions on the frons relative to M. frontoepipharyngalis. In representatives of the majority of tribes the origin of the muscle is located in the region of the frons lateral to the paths of the bundles of M. frontoepipharyngalis. The relationship indicated is characteristic of Pimeliini (Sternodes caspicus Pall., Diesia sefirana Rtt., Trigonoscelis nodosa Fisch.-W., Lasiostola elongata Kr., Ocnera triangularis Faust., Pachyscelis pygmaea Mén., Pimelia cephalotes Pall. Sympiezocnemis gigantea Fisch.-W.). Platyopini (Habrobates vernalis Sem.), Akidini (Cyphogenia gibba Fisch.-W., Sarathropus depressus Zoubk.), Adesmini (Adesmia karelini Fisch.-W) Erodiini (Diaphanidus antennatus Rtt., Ammozoum ferrugineum Fisch.-W. [Fig. 9], Arthrodosis orientalis Faust.), Tentyriini (Microdera minax Rtt., Tentyria gracilis A.Bog. in litt., Alcinoe helopioides Men.), Epitragini (Leptosphena rubripes Rtt.), Zophosini (Zophosis punctata Br.), Lachnogyini (Lachnogya squamosa Mén.), Leptodini (Leptodes remicola A. Bog and Kryzh. in litt. [Fig. 10]), Stenosini (Oogaster lehmanni Mén., Dichillus tenebrosus Rtt.), Platamodini (Platamodes dentipes Mén.), Cossyphini (Cossyphus tauricus Stev.), Tenebrionini (Tenebrio molitor L.), Diaperini (Alphitophagus bifasciatus Say.), and also in Asida lutosa Sol. and Diaperis boleti L., which are absent from Turkmenia.

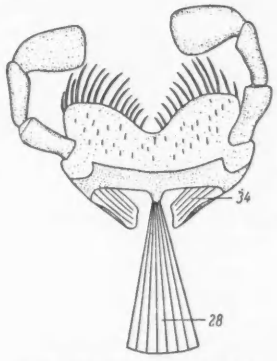

Fig. 7. Structure of the Submental Muscle of the Prementum of Adesmia karelini Fisch.-W., view from below.

On the other hand in Blaptini (Dila seriata Rtt., Blaps titanus Mén., B. scutellata Fisch.-W., Prosodes solskyi Faust [Fig. 11], Tagona macrophthalma Fisch.-W.) and a few Opatrini (Weisea sabulicola Sem., Lobodera fartalis Rtt.) the origin of the frontal muscle of the hypopharynx is situated medially to the path of the fibers of the frontal muscle of the epipharynx. The origins of both bundles of the latter muscle are widely set. In addition to Opatrini, much nearer to Blaptini in the type of arrangement of the frontal muscles of the hypopharynx and epipharynx, stand the North American tenebrionids of the genus Eleodes. In particular, in E. dentipes the principal mass of fibers belonging to M. frontoepipharyngalis run lateral to M. frontohypopharyngalis, and only individual fibers are situated medially.

Finally, Helopini (Hedyphanes seidlitzi Rtt., Zophohelops badghysi G. Med. in litt., Catomus subniger Rtt.), Opatrini (Opatroides punctulatus Br. [Fig. 12], Lobodera rufescens Muls.), Pedinini (Dissonomus tibialis Rtt., Aphaleria pygmaea Fisch.-W., Cabirus obtusicollis Rtt.), Platyscelini (Micro platyscelis latiuscula Mén.), Belopini (Belopus trogosita Motsch.) and Netuschilia hauseria Rtt. from Lachnogyini occupy an intermediate position between the first two groups. In these forms the bundles of M. frontohypopharyngalis arise on the frons under the bundles of M. frontoepipharyngalis and each splits up into two approximately equal parts.

The paired bundles of the cibarial and pharyngeal muscles do not develop ligaments and are directly attached to the stomodeal intima.

43. Clypealmuscle of the cibarium (M. Clypeopalatalis) (Figs. 4, 10, 11) consists of one pair of bundles arising on the clypeus behind the transverse ridge on which the clypeal membrane is inserted. The muscle appears to be the sole dilator of the cibarium.

44. Anterior frontal muscle of the pharynx (M. clypeobuccalis) (Figs. 4, 10, 11) as a rule, consists of a few pairs of bundles inserted on the dorsal wall of the pharynx between the fibers of the pharyngeal compressors. In Pimeliini, Akidini, Adesmini, Tentyriini, Zophosini, Leptodini, Stenosini, Platamodini, and others, M. clypeobuccalis consists of three pairs of bundles; four pairs in all Blaptini.

45. Anterior frontal muscle of the pharynx (M. frontobuccalis anterior) (Figs. 4, 10, 11) consists of one pair of thin bundles inserted on the pharynx directly behind the brain commissures to the frontal ganglion, medial to the bundles of M. frontoepipharyngalis. In the overwhelming majority of instances the origin of this muscle is situated behind the origin of M. clypeobuccalis The bundles of M. frontobuccalis lie lateral to the bundles of M. clypeobuccalis only in a few Pimeliini.

46. Posterior frontal pharyngeal muscle (M. frontobuccalis posterior) (Figs. 4, 10, 11). As in the preceding pharyngeal muscle, this muscle is also inserted on the frons medial to the path of the bundles of M. frontoepipharyngalis (in a few individuals of Pimelia cephalotes Pall., above them). Both muscles in question are inserted on the pharynx directly in front of the brain. Sometimes the bundles are thin (Adesmia karelini Fisch.-W.), but in no tribe was their complete disappearance noticed.

47. Lateral frontal muscle of the pharynx (M. frontobuccalis lateralis) (Figs. 4, 10) is rarely met with

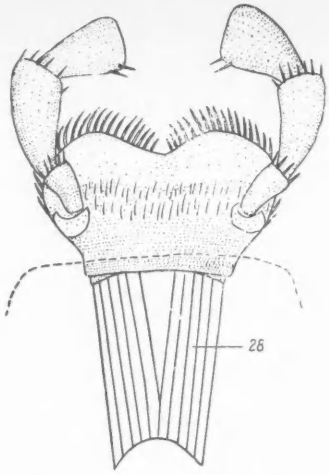

Fig. 8. Structure of the Submental Muscle of the Prementum of Blaps titanus Mén., view from below.

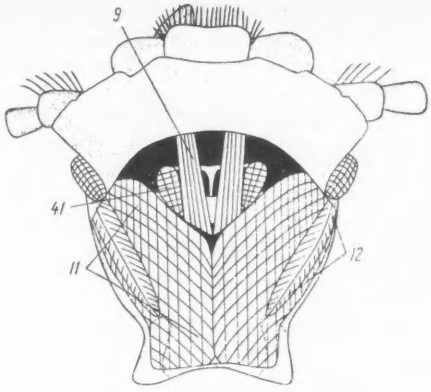

Fig. 9. Arrangement of the Muscles in the Head of Ammozoum ferrugineum Fisch.-W. (pharyngeal muscles not shown), view from below.

in Tenebrionidae. In Blaptini it arises more or less completely fused with the bundles of the preceding muscle. In Leptodes rimicola A. Bog and Kryzh. in litt. (Fig. 10) and Pachyscelis pygmaea Mén. the thin bundles of M. frontobuccalis lateralis arise on the frons lateral to the origin of the bundles of M. frontoepipharyngalis; in Pimelia cephalotes Pall. they arise above them and, consequently, run between them. On the pharynx the bundles are inserted medial to the place where the connectives of the frontal ganglion and tritocerebrum fuse.

All the clypeal and frontal muscles of the pharynx appear to be dilators, antagonists to the pharyngeal compressors and antagonistic synergists to the muscles of the ventral wall of the pharynx.

48. Anterior tentorial muscle of the pharynx (M. tentoriobuccalis anterior) (Fig. 4) emerges from the tentorial bridge in the form of two straplike bundles inserted in the wall of the pharyngeal ridge above the buccal orifice. In those instances in which the tentorial bridge is absent (Erodiini) the origin of the muscular bundles shifts to the dorsal edge of the posterior arms of the tentorium adjoining the origin of the posterior tentorial pharyngeal muscle. When the muscle contracts the wall of the pharyngeal apophysis falls.

50. Posterior tentorial muscle of the pharynx (M. tentoriobuccalis posterior) (Fig. 4) has its origin on the dorsal edge of the posterior arm of the tentorium behind the tentorial bridge. At the site of attachment the fibres of the given muscle serve the ventral and partly the lateral walls of the pharynx above and in front of the brain. The muscle appears to be a dilator of the pharynx.

The intrinsic musculature of the foregut within the head consists of the transverse pharyngeal (M. transversalis buccae 67), the stomodeal ring (M. annularis stomodaei 68) and the stomodeal longitudinal (M. longitudinalis stomodaei 69) muscles. The fibers of the first are in the form of oblique-transverse and transverse bundles situated on the dorsal wall of the pharynx and cibarium; the fibers of the second set of muscles cover the pharynx behind the frontal ganglion. Above the transverse and circular musculature lie the short fibers of the longitudinal stomodeal muscle. Alternate contraction of the circular and longitudinal muscles gives rise to peristaltic movements of the pharynx.

In the musculature of the mouth parts and pharynx one can distinguish a few groups of muscles responsible for the various phases in passing the food bolus to the buccal aperture and swallowing it.

The first group comprises the internal and external muscles of the labrum, mandible, maxillae and labium. The preparation of the food bolus and its passage through the buccal aperture depend on the action of the muscles of this group.

The second group includes the cranial and tentorial dilators of the pharynx and cibarium. When the muscles of this second group contract, the pharyngeal cavity in the region of the buccal aperture expands considerably since the pharyngeal apophysis is depressed and the dorsal wall of the cibarium and pharynx are slightly raised. Owing to this the food bolus can freely enter the pharynx. The contraction of the pharyngeal dilators in the region of the forebrain is dependent upon the features mentioned in the work on the anterior parts of the pharynx.

The third group of muscles includes the intrinsic musculature of the pharynx and the frontal muscle of the hypopharynx. The contraction of the muscles of this

group closes the buccal aperture completely. This results from the fact that the contraction of the transverse muscles causes the dorsal wall of the pharynx to be squeezed tightly from above to the origin of the mandibles and their pharyngeal lobes. M. frontohypopharyngalis, on contraction, slightly raises the corners of the buccal aperture and squeezes them from the side to the pharyngeal lobes of the mandible. Finally, the apophysis on the bottom of the pharynx is raised a little on contraction of the anterior bundle of circular muscles and is compressed from below to the ventral surface of the pharyngeal lobes. After the closing of the buccal aperture, which prevents the reverse movement of the food, the peristaltic movements of the pharynx begin, following the contraction of the circular and longitudinal stomodeal muscles.

In this way the pharyngeal lobes of the mandible and the pharyngeal apophysis in Tenebrionidae act as special valves at the entrance of the pharynx. In this connection there exists a definite interdependability in the structure of the pharyngeal apophysis and the pharyngeal lobe of the mandible. Two types can be distinguished in the structure of the 'pharyngeal valves'. In Blaptini and Opatrini the pharyngeal lobes of the mandible are excessively large and are attached along the whole of the posterior edge of their molar surface. The apophysis at

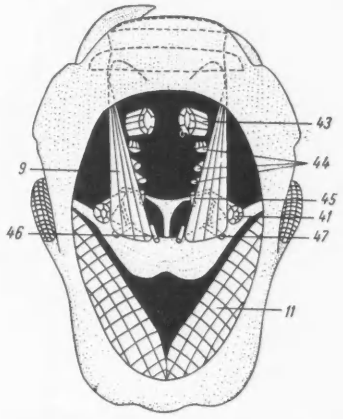

Fig. 10. Arrangement of the Muscles in the Head of Leptodes rimicola A. Bog. and Kryzh. (intrinsic musculature of the stomadeum not shown), view from above.

the bottom of the pharynx in such forms is rather weakly developed. Therefore, the principal role of the 'pharyngeal valves' is taken care of by the mandibular lobe. In Pimeliini, Platyopini, Zophosini and Adesmini the pharyngeal lobes of the mandible are developed only in the upper part of the posterior edge of the molar apophysis. In the formation of the 'pharyngeal valves' in these forms the pharyngeal apophysis plays a more important part. In larvae in which the mandibles never have pharyngeal lobes, the pharyngeal apophysis is characteristically very well developed. A number of other groups (Akidini, Tentyriini, Erodiini) occupy an intermediate position between Blaptini and Pimeliini in the structure of the 'pharyngeal valves'. Although the pharyngeal lobes in these forms are attached along the whole of the posterior edge of the molar area, they are not so massive as in Blaptini.

The closing of the buccal aperture may have a special significance in the elimination of the direct connection of the lumen of the foregut with the external surroundings. That may be the reason why the anterior part of the pharyngeal apophysis differs from the posterior by its greater thickness and its stronger pigmentation.

It is interesting to trace the fate of the individual groups. Table 1 shows that out of the 48 muscles known to belong to the mouth parts and pharynx in Pterygota, 27 were observed in Tenebrionidae.

The postcerebral, cranial and tentorial dilators of the pharynx and the muscles of the cibarium are completely absent. The muscles of the labium undergo a strong reduction; out of 9 muscles only 3 are preserved. The absence of antagonists in the labial muscles is reflected in the passive character of the return movement of the prementum and palp which depends on the elasticity of the connecting membrane. It seems that this is connected with the fact that in the process of food intake the labium, instead of the dorsal surface of the hypopharynx, acts chiefly as a directive surface. On the contrary, the musculature of those appendages and organs which take an active part in biting off, holding and transporting the food is made up of an antagonistic pair, which accelerates the work of the organ.

Outside the family Tenebrionidae the variation in the constitution of the musculature of the mouth parts and pharynx is, on the whole, small and affects exclusively the cranial musculature of the pharynx. In particular, in certain Pimeliini (Pimelia cephalotes Pall., Sympiezocnemis gigantea Fisch.-W.) and Leptodini (Leptodes rimicola A.Bog. and Kryzh.) there is a lateral frontal pharyngeal muscle, whereas in Akidini, Adesmini, Erodiini, Tentyriini, and many Pimeliini (Ocnera, Trigonoscelis, Sternodes and others) this is absent. As already noted the number of bundles in the clypeal muscle of the pharynx varies.

In differentiating the most important types of musculature of the mouth appendages in Tenebrionidae, the arrangement of the frontal muscles of the hypopharynx and epipharynx relative to one another, as well as certain features in the structure of M. submentopraementalis, were taken as a basis.

The first type is peculiar to Blaptini. It is characterized by the medial situation of the origins of the bundles of M. frontohypopharyngalis relative to M. frontoepipharyngalis and the paired structure of M. submentopraementalis.

The second type differs from the first in the lateral position of the bundles of M. frontohypopharyngalis relative to M. frontoepipharyngalis and the unpaired structure of M. submentopraementalis. It is peculiar to Pimeliini, Platyopini, Akidini, Epitragini, Tentyriini, Zophosini, Erodiini , Adesmini, Cossyphini, Diaperini, Lachnogyini, Leptodini. Stenosini, Platamodini, and Tenebrionini.

The third type occupies an intermediate position between the other two types. It is characterized by the unpaired structure of M. submentopraementalis and also by the fact that the origin of the bundles of M. frontohypopharyngalis divides the bundles of M. frontoepipharyngalis into two. The third type is peculiar to Helopini, Pedinini, Platyscelini, and Belopini, Notwithstanding the variation in the position of M. frontohypopharyngalis (in one case as in the first type, in the other as in the third type), Opatrini also falls into the third group.

It seems to us that the above-mentioned types represent definite stages in the evolution of the corresponding musculatures of the Tenebrionidae, in which the first type preserves a greater part of the primitive features in comparison with the third and particularly with the second. The idea expressed is confirmed by the distribution of the frontal muscles of the epipharynx and hypopharynx in the representatives of certain primitive and ancient orders of insects, for example, in adult Isoptera, the nymph of Plecoptera, the larva of Megaloptera (Cook [1943], Figs. 3, 6, 14) and also in the imago of Blattodea (Dorsey [1943] Fig. 1). In these forms the bundles of M. frontohypopharyngalis arise on the frons, medial to M. frontoepipharyngalis. There is no doubt also about the primitive character of the paired structure of M. submentopraementalis.

The shift in the region of the frons of the origin of the bundles of M. frontohypopharyngalis in a lateral direction should be considered as a progressive effect through which the condition for the more complete utilization of the inner surface of the capsule for the location of the origins of the muscles has been realized. Thus, it is obvious that the shift of the origins of the bundles of M. frontoepipharyngalis in Blaps or Prosodes (Fig. 11) to the middle line would allow it to slip in front of the origin of M. craniomandibularis internus. Consequently, the run of the fibers of M. frontoepipharyngalis and, the effect of their contraction (in the given instance the amplitude of the shift of the labrum in the anterior-posterior direction), would remain unaltered. In the forms with which the second and third types of the structure of the musculature of the mouth parts are associated this possibility is more or less completely realized. As already noticed above, opposite points of view exist with respect to the value of the shift of the muscles on the head capsule as a criterion of the homology of the sclerites. A study of the distribution of the muscles in representatives of various tribes shows that the origins of the muscles of the mouth appendages and pharynx are quite mobile. By way of example it is sufficient to quote the shift of the bundles of the frontal muscles of the

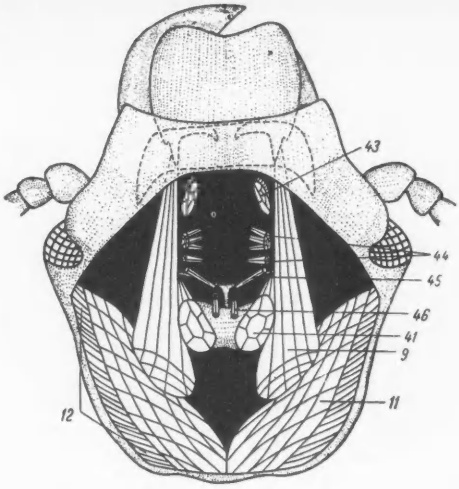

Fig. 11. Arrangement of the Muscles in the Head of Prosodes solskyi Faust. (intrinsic musculature of the stomodeum not shown), view from above.

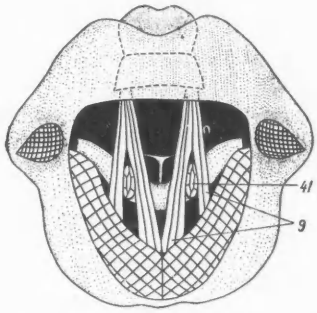

Fig. 12. Arrangement of the Muscles in the Head of Opatroides punctulatus Br. (without the pharyngeal muscles), view from above.

labrum and hypopharynx. Although these changes take place in the frontal region, they are always accompanied by the complex process of the 'stepping over' of M. frontohypopharyngalis across the bundles of M. frontoepipharyngalis.

In this connection the study of the cranial musculature of the larva is of great interest. It is well known that in insects a portion of the larval musculature may be transferred to the body of the imago. A preliminary study of the musculature of the mouth appendages and pharynx of larval Tenebrionidae shows that, even in forms which differ considerably in the structure of the corresponding musculature in the imaginal phase (for example Blaptini and Pimeliini), there are no fundamental differences. On the other hand, the cranial musculature in the larva naturally differs from that of the imago in the

composition and arrangement of the muscles. This permits one to draw the conclusion that the developments in the constitution of the cranial musculature of the imago are determined by internal metamorphic processes and are not immediately connected with structural features in the musculature of the larva.

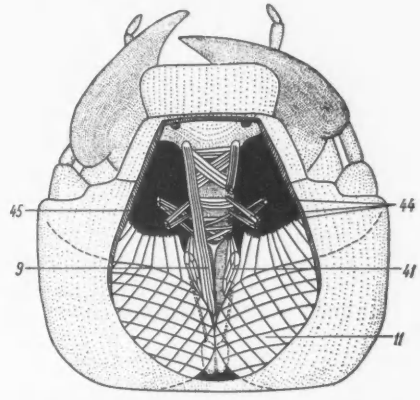

Fig. 13. Arrangement of the Muscles in the Head of the Larva of Pimeliae cephalotes Pall., view from above.

Thus, in the larva of Pimelia cephalotes Pall. (Fig. 13) and Blaps deplanata Mén. the whole of the cervical portion of the head capsule is occupied by the origin of the internal cranial muscle of the mandible which here, as in the imago, is divided into parietal and genal parts by the origin of the external cranial muscle of the mandible. The brain is moved backwards a long way and is covered above by the origins of the internal cranial muscle of the mandible. In contrast to this the frontal ganglion keeps its position relative to M. frontohypopharyngalis and M. frontobuccalis anterior and that is why it is far removed from the brain, with which it is connected by long thin commisures. The labrum has one pair of cranial muscles arising, one near the other, on the posterior part of the frons in front of the brain (Fig. 13, 9). Cook [1944] presumes this muscle to be the anterior palatal, that is, M. clypeopalatalis according to the terminology of Keler [1955]. Das [1937] in determining this muscle earlier in the larva of Tenebrionidae and Curculionidae refers to it as the musculature of the tormae. Dorsey [1943] treated it in a similar way. For an elucidation of the question under discussion one must study the muscle attachments on the stomodeum in larvae of various families of Coleoptera. In the larvae of Tenebrionidae the fibers of both bundles are inserted far behind the base of the labrum by long tendons running to the end of the epipharyngeal tormae. Since the tendons are completely fused with the dorsal wall of the cibarium they are not very noticeable on its surface. Consequently, the muscle in question may easily be mistaken for the palatal. All these instances are favorable to the consideration that the homologies developed by Das and Dorsey are the more accurate. It should be noticed that in the larvae of Blaptini the sclerites of the tormae fuse along the middle line and thereby the connection of the muscle with the whole of the lip is strengthened.

In spite of the single origin, the external musculature of the labrum in the imago and larva sharply differ according to the position of the fibers relative to the cranial muscles of the pharynx. In the larva the bases of M. clypeobuccalis and M. frontobuccalis anterior are situated lateral to the path of the fibers, of M. frontoepipharyngalis, while in the imago they are always placed between the bundles of this muscle. It is characteristic also that M. frontohypopharyngalis always arises lateral to M. frontoepipharyngalis as is found in Pimeliini, Akidini, Tentyriini, and other tribes, beside Blaptini, Platyscelini, Opatrini, and Helopini.

As is seen from the Table, applied to the work of Dorsey [1943], a similar relationship of the cranial musculature of larva and imago is observed in representatives of many families and evidently is characteristic for Coleoptera as a whole. Thus, the cranial musculature in the larva in members of various families has more common features in arrangement than in the larva and imago of a single species.

The particular location or position of the origin of the precerebral muscle of the pharynx on the genal surface of the head capsule is extemely variable. In Blaptini (Blaps scutellata Fisch.-W., Prosodes solskyi Faust.) Adesmini (Adesmia karelini Fisch.-W.). Akidini (Cyphenogenia gibba Fisch.-W., Sarathropus depressus Zoubk.), and many Pimeliini (Sternodes caspicus Pall., Diesia sefirana Rtt., Ocnera imbricata Fisch.-W.) the bundles of M. frontobuccalis anterior have their origins on the head capsule behind the origin of M. clypeobuccalis. In the given instances it is possible to trace on the capsule the limits between the preoral and postoral groups of the pharyngeal muscles, divided at the pharynx by the cerebral commissures of the frontal ganglion. Nevertheless, in certain Pimeliini (Pimelia cephalotes Pall., Sympiezocnemis gigantea Fisch.-W., Trigonoscelis nodosa Fisch.-W.) The anterior postoral muscle (M. frontobuccalis anterior) arises on the head capsule in such a way that its origin closely abuts laterally on the origin of M. clypeobuccalis, being related to the preoral region. It is characteristic that the third bundle of M. clypeobuccalis arises behind the origin of M. frontobuccalis anterior. In the larva all the cranial dilators of the pharynx arise on the frons behind the frontoclypeal suture. Besides that, the first and second bundles of M. clypeobuccalis intersect not only with the third bundle of this same muscle but also with the postoral M. frontobuccalis anterior. It is quite evident that in a number of Pimeliini and also in the larva, the muscle of one group intrudes into the region where the muscles of the other group arise. Following this arrangement the pharyngeal muscles of the head capsule cannot serve in the Tenebrionidae as a criterion

TABLE 1. Numerical Constitution of the Musculature of the Mouth Parts and Pharynx of Beetles of the Family Tenebrionidae

	Number of muscles known in Pterygota	Number of muscles observed in Tenebrionidae
Labrum	4	2
Mandible	4	2
Maxillae	12	9
Labium	9	3
Salivarium	4	0
Hypopharynx	2	1
Cibarium	1	1
Anterior part of pharynx	7	6
Posterior part of pharynx	2	0
Intrinsic musculature of pharynx	3	3
Total	48	27

for the determination of the boundaries between clypeus and frons. The rules for the interchange of the other muscles permits one to conclude that in the Tenbrionidae the positions of the muscles on the head capsule are closely connected with their functions, with the peculiarities of their structure and with the disposition of the organs to which they are not strictly associated with definite parts of the head capsule (frons, clypeus).

Cook [1944], in his work on the morphology of the labrum and clypeus, draws his conclusion about the relative independence of the origins of the muscles from a study of ectodermal structures. However, his conclusion is based on an unusual interpretation of the cranial sutures in which the author appears to be a follower of Ferris. In contrast to the majority of morphologists, who acknowledge the primitive character of only the posterior occipital suture, Ferris [1942, 1943] affirms that a number of other 'great cranial sutures' (great suture of the head) appear to be intersegmental lines. According to Ferris, the region of the head beneath the branches of the suture, having the form of an inverted letter V, is considered to be the frons (according to another terminology of this author 'the antennal segment'), if the branches terminate lateral to the bases of the antennae, or as the clypeus, if the branches are situated between the bases of the antennae. Du Porte [1946] showed that the sutures, determined by Cook in accordance with Ferris' conception as frontal, in the larva of Coleoptera, Nematocera, and Lepidoptera and also in the imago of Psocus do not always appear to be identical developments within the limits of the frons. Consequently, in the determination of this or that part of the head capsule (in this instance the frons), Cook maintains that the shifting of the origins of the muscles begins with the surfaces of those regions. Such an opinion, combined with the elements of subjectivism in the determination of the homologies of individual parts of the head capsule, meets with many objections and cannot be considered as sufficiently proved. For example, in those conditions in which the boundaries of the sclerites or head regions are not clear, the differences in the mutual positions of the individual pairs or groups of muscles can be indicative of the shift of the origins of the muscles in forms which are close in systematic relationship, within the limits of family or subfamily

TABLE 2. Relative Positions of M. frontohypopharyngalis (M. fh.) and M. frontoepipharyngalis (M.fe.), one to the other, Characteristic of Certain Tribes in the Family Tenebrionidae

First group: M. fh. arises medial to M. fe.	Second group: M. fh. is split by the bundles of M. fe.	Third group: M. fh. arises lateral to M. fe.
Blaptini	*Eleodini*	*Diaperini*
	Pedinini	*Tenebrionini*
	Opatrini	*Cossyphini*
	Platyscelini	*Pimeliini*
	Helopini	*Platyopini*
	Bolitophagini	*Asidini*
	Belopini	*Akidini*
	Lachnogyini	
		Leptodini
		Stenosini
		Platamodini
		Epitragini
		Tentyriini
		Adesmini
		Zophosini
		Erodiini

The question arises as to whether one can make use of the differences in the structure of the musculature of the mouth parts and pharynx in phylogenetic relationships in the family Tenebrionidae. From Table 2, in which

the tribes are divided into three groups on the basis of the interrelation of M. frontohypopharyngalis and M. frontoepipharyngalis, it is seen that these groups do not express any real filial connnections. In particular, the third group includes tribes both nearly related and also very distant in phylogenetic relationship. Diaperini, Tenebrionini, and Cossyphini are quite near the tenebrionids of the first and second groups in structure. Hence, a few features in the structure of the musculature of the mouth parts could spring up in parallel in the tenebrionids. This lessens their importance as criteria of the phylogenetic relationships outside the family Tenebrionidae. However, rare instances of divergence from a definite type of structure outside the tribe and the resemblance of these types to representatives of nearly related tribes (for example, in Pimeliini and Platyopini, in Tentyriini and Epitragini, etc.) allow one to utilize the features under investigation as supplementary aids in the elucidation of filial relationships among typical groups in the family Tenebrionidae.

The morphology of the mouth parts stresses the phylogenetic propinquity of Blaptini, Opatrini, Pedinini, and Platyscelini. From the tenebrionids known from Turkmenia it is only among the Opatrini that an arrangement of the frontal muscles of the epi- and hypopharynx, such as is seen in Blaptini, is found.

Pimeliini and Platyopini are generally related with Blaptini (Seidlitz [1898]; Gebien [1910]; Rietter [1917]), but they differ sharply from the later in a very large number of characteristics in internal and external structure of the mouth parts. It is evident that both tribes should be considered as relatively small, but strongly deviating, morphological branches of the tenebrionids of the tenebrionid stem.

SUMMARY

As a result of the study of the musculature of the mouth parts and pharynx of the desert Tenebrionidae of Turkmenia the insects were divided into three groups, based on the position of Musculus frontohypopharyngalis and M. frontoepipharyngalis relative to one another, and also on the structure of M. submentopraementalis. In the larvae of Tenebrionidae and cetain imagos of the tribes of Pimeliini (Pimelia, Sympiezocnemis) the bundles of the preoral and postoral groups of precerebral muscles of the pharynx intersect. Because of this arrangement the origins of the muscles of the pharynx cannot be used to determine the limits between the regions of frons and clypeus in Tenebrionidae.

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MORPHOLOGY AND TAXONOMY OF COCCINELLID LARVAE FROM SOUTHEAST KAZAKHSTAN

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The morphology and taxonomy of coccinellid larvae have received little study. Our own literature contains a few works devoted to this question. Vasil'ev [1910], Porchinskii [1912], and Brunner [1947] give only brief descriptions of the larvae of some coccinellid species with reference mainly to the form and coloration of the body. Bogdanov-Kat'kov [1927] gives a more detailed description of the structure of the melon ladybird (Epilachnia chrysomelina F.); the fullest account of the morphology of coccinellid larvae is given by Rubtsov [1952] for the case of Lindorus lophantae Blaisd.

Among the foreign authors who have studied the morphology of coccinellid larvae.Gage [1921], Binahgi [1941], and Van Emden [1949] have produced interesting works. The last author has published a key to the later-instar larvae of the British coccinellids. This key was constructed without reference to the chaetotaxy of the larvae, and this considerably complicates the identification.

The author of the present article has studied the morphology of 32 species of coccinellid larvae from southeast Kazakhstan and has compiled a key for their determination.

In order to obtain all the larval instars of different species of coccinellids we resorted to rearing them in laboratory conditions. For this purpose beetles of both sexes of one species were placed in wide tubes or half-liter glass jars, in which plants with aphids and small tufts of dry cotton wool had been installed. The mouths of the tubes and jars were covered with gauze. The food in the containers was changed daily. In most cases the females laid eggs on the tufts of cotton or on the plants in the cages. The eggs were carefully transferred to wide tubes. If the eggs were not collected in time the beetles often ate them. The larvae which hatched out from the eggs were immediately transferred in twos or threes to separate tubes containing plants and aphids. If there was not sufficient food the larvae ate one another, and larvae left unattended soon perished. As growth proceeded,larvae of different instars were fixed at the times of changing the food and cleaning the containers; the color of the larvae before fixation was recorded.

The structure of the larvae was studied on microscopic whole mounts. For this purpose the earlier-instar larvae were soaked, and the later-instar larvae boiled, in 5 % caustic soda solution, after which they were passed through alcohol, carbol-xylene, xylene, and finally mounted in Canada balsam.

When we found larvae of unknown species in the field we fixed some of them, and reared the others to the adult insect, in order to determine the species.

When there is a shortage of specimens or if a rapid preparation is required we can recommend using the cast larval skins. The cast skin is placed in xylene immediately, and then mounted in Canada balsam.

Since our own literature is lacking in information on the morphology of coccinellid larvae, we will give a brief account of the characters of taxonomic importance.

Coccinellid larvae are of the campodeiform type (Figs. 16, 17, 30, 37). The head is usually roundly quadrate. The epicranial suture is well developed, except in the case of the later-instar larvae of the tribes Scymnini and Hyperaspidina (Fig. 13), and consists of a stem and a pair of arms (Figs. 18, 38). In the majority of larvae of the subfamily Coccinellinae the epicranial stem is absent, and then the epicranial arms begin directly from the occipital foramen (Fig. 12, 31). The clypeal suture is developed in varying degree. On the sides of the head there are three round ocelli of approximately equal size. Only in larvae of the tribes Scymnini and Stethorini are the fore two ocelli much larger then the hind, third, ocellus (Fig. 12). The antennae are two- or three-segmented (Fig. 21), and , except in the case of larvae of the tribe Scymnini, are well sclerotized. The labrum is in the form of a transverse plate with three to four pairs of setae. It deviates markedly from the general type only in larvae of the tribe Psylloborini, where it has a hemispherical form and is covered with numerous setae (Fig. 31). The mandibles are sickle shaped, usually powerful, and heavily sclerotized; in phytophagous larvae they are multidentate (Figs. 20, 32-34), whereas in carnivores they have one to two teeth at the apex (Fig. 19). In larvae of the tribes Scymnini and Stethorini the mandibles are small, with an internal duct for sucking up liquid food. The inner lobe of the maxillae is absent. The maxillary palps are three-segmented while the labial palps are two-segmented. The submentum is represented by an entire, more or less narrow plate, but in larvae of the tribe Psylloborini it has an excavation in the center, or else consists of two lobes and is covered with numerous rodlike setae (Fig. 31).

The chaetotaxy of the thoracic and abdominal segments of the larvae is complex and exceedingly diverse. It has great taxonomic value, and hence in descriptions of the larvae it is essential to maintain a strict differentiation of the concepts and to stick to a definite terminology, otherwise the diagnosis of species would be quite impossible. For denoting the various outgrowths on the body of the larvae we adopt the following terminology of Gage [1921]: seta, chalaza, verruca, struma, parascolus and sentus (Figs. 1-11).*

The tergites of the thoracic segments of the larvae are furnished with two or four, more or less sclerotized plates, with numerous chalazae and setae, or occasionally with parascoli or senti. In larvae belonging to the tribes Scymnini and Hyperaspidini, the sclerotized plates on the thoracic tergites are absent, and are replaced by verrucae in the first, and by setae in the second. The chaetotaxy of the abdominal tergites is very diverse. On each tergite there is a row of six verrucae (Fig. 14), strumae, parascoli or senti, which form dorsal, dorsolateral and lateral groups. In correspondence with this, the verrucae on the abdominal sternites are named ventral, ventrolateral and paralateral. The legs are long or short, depending on the tribe to which the larvae belong. Larvae of the tribes Scymnini and Hyperaspidini, from instar II on, are covered with white, waxy excretions.

* A seta is placed directly on the body surface without any elevation. A chalaza is a seta mounted on a small cylindrical or roundly triangular process called the base. A verruca is a round elevation invested with seta. A struma is an elevation covered by chalazae with low bases. A parascolus is a long projection covered by chalazae; when it is low, it looks like a number of chalazae with the bases considerably increases in size or elongated. A sentus is a long, hornlike, unbranched projection with several setae.

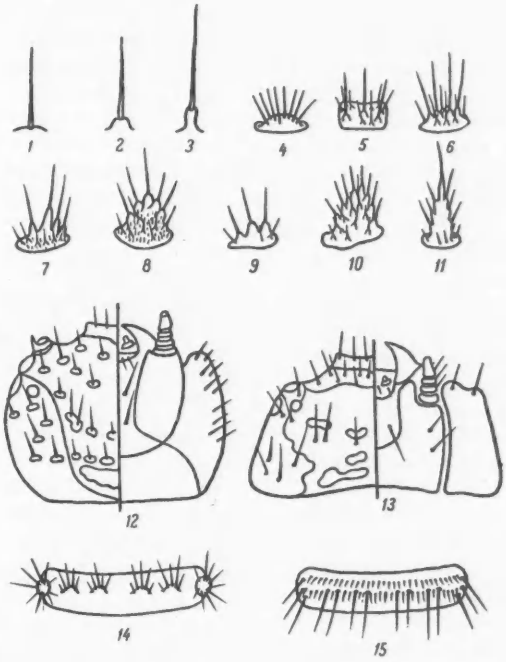

Fig. 1 - 15. Features of chaetotaxy of coccinellid larvae of different tribes. 1) Seta; 2) chalaza of Coccinella 11-punctata L.; 3) chalaza of Coccinella divaricata Ol.; 4) verruca of Paramysia oblongoguttata L.; 5) struma of Bulaea lichatschovi Humm.; 6) struma of Coccinula redimita Ws.; 7) parascolus of Adonia variegata Goeze; 8) parascolus of Hippodamia 13-punctata L.; 9) parascolus of C. 11-punctata L.; 10) parascolus of C. divaricata Ol., 11) sentus of Anatis ocellata L.; 12) head of Stethorus punctillum Ws.; 13) head of Oxynchus sp.; 14) abdominal tergite of Scymnus frontalis Fabr.; 15) abdominal tergite of Oxynychus sp.

Coccinellid larvae undergo considerable changes with age. In this connection the larvae can be divided into two groups according to their structural features : the first group includes larvae of instars I and II, the second includes larvae of instar III and IV . Within these groups the structure differs in very slight details but the groups themselves are separated by more distinct characters. Firstly, differences in coloration are noted. Larvae of instars I-II are usually unicolorous or with small spots, whereas larvae of instars III-IV have bright spots standing out clearly against the ground color of the body. There are changes in the ratio of the length of the legs to the greatest width of the body, and in the ratio of the length of the prothorax to the length of the head. In instars III-IV the limbs and the head are relatively smaller than in instars I-II. In instars I-II the epicranial suture is long, and reaches the bases of the antennae; in instars III-IV the epicranial suture is much shorter or completely absent. The greatest changes are observed in the chaetotaxy. The plates situated on the thoracic tergites of instars I-II are weakly sclerotized, covered with sparse chalazae, and bear an embryonic spine to facilitate emergence from the egg (Fig. 16). In instars III-IV the plates on the thoracic tergites are more heavily sclerotized, beset with numerous chalazae and do not have an embryonic spine (Fig. 17). While the abdominal tergites in instars III-IV are invested with well-developed senti, parascoli, strumae or verrucae with numerous chalazae or setae (Fig. 17), in instars I-II there formations are small and low, with sparse chalazae or setae (Fig. 16).

From a comparative study of larvae in different instars we managed to establish that the structure of the mouth organs undergoes no significant changes with age. On the other hand, the coloration, body size and chaetotaxy, with the basic type still being retained, differ markedly in instars I-II and III-IV. This circumstance had to be taken into account in the compilation of the keys. Hence, in compiling keys to the tribes of larvae, we have used first of all the structure of the mouth parts as a constant character in all instars. Then we have considered the form of the head, the ratio of its length to its width, the presence or absence of sclerotized plates on the thoracic tergites, and finally the chaetotaxy of the abdominal segments. Our key is therefore suitable for the determination of tribes from larvae of any instar.

In the diagnosis of genera and species of coccinellid larvae we have considered features of the chaetotaxy, which , as we already said above, is subject to considerable changes during the growth of the larvae. In view of this it is impossible to compile tables suitable for identifying the majority of genera or species of larvae of any instar, and consequently we first give a key for determining the larval instar, and then generic and specific keys separately for the younger (I-II) and older (III-IV) instars. For diagnosis of the genera we have as far as possible used larval characters which do not change with age. Thus, for most larvae of the tribe Coccinellini it is possible to compile a general key to the genera of larvae irrespective of their instar, but it would be impossible to separate larvae of the genera Coccinella, Synharmonia and Adalia without taking age changes into account, and representatives of these genera are the most widely distributed and numerous in the fauna of our country, and their identification has great practical importance. It should be noted that larvae of closely related species, and sometimes even of genera in the earlier instars, can only be distinguished with difficulty†.

KEY TO TRIBES OF LARVAE OF SUBFAMILY COCCINELLINAE

1 (4). Mandibles with two or more apical teeth; if mandibles have two teeth then the epicranial stem is always absent.

2 (3). Head of roundly quadrate form. Mandibles with two or three apical teeth (Figs. 19, 20). Labrum represented by a narrow transverse plate with two to four pairs of setae. Submentum entire, with a few setae of usual structure. Abdominal tergites with parascoli, senti, strumae or verrucae (Figs. 4-11). . . . . Coccinellini.

3 (2). Head of roundly triangular form (Fig. 31). Mandibles with six to eight teeth (Figs. 32-34). Labrum represented by a roundly triangular plate with numerous setae. Submentum divided into two parts or entire, with numerous rodlike setae (Fig. 31). Abdominal tergites with strumae. . . . . Psyllobórini.

4 (1) . Mandibles with one apical tooth; if there are two teeth, the epicranial stem is well developed (Fig. 38).

5 (6). Head of rectangular form, roughly as long as broad, heavily sclerotized (Fig. 39). Abdominal tergites with senti (Figs. 40, 41). . . . . Chilocorini.

6 (5). Head broader than long (Figs. 12, 13). Abdominal tergites with verrucae or setae (Figs. 14, 15) .

7 (8). Plates on thoracic tergites well developed. Larvae not covered with waxy excretions . . . . . Stethorini .

8 (7). Plates on thoracic tergites weakly developed. Larvae covered with waxy excretions.

9 (10). Base of maxillae weakly sclerotized, of oval form, and not fused with gula. Tergites of thorax and abdomen with verrucae (Fig. 14). . . . . Scymnini .

10 (9). Base of maxillae heavily sclerotized, of rectangular form, and fused with gula (Fig. 13). Tergites of thorax and abdomen covered with setae (Fig. 15). . . . . Hyperaspidini.

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† An account of the morphology of coccinellid larvae of different species is given by the author in other papers on the characteristics of separate tribes of this family.

KEY TO LARVAL INSTARS IN SUBFAMILY COCCINELLINAE

1 (2). Plates on thoracic tergites weakly sclerotized, covered with numerous chalazae or setae and with a well-developed embryonic spine. Senti, parascoli, strumae or verrucae on abdominal tergites small (Fig. 16). Epicranial suture always developed. Larvae unicolorous or with weakly developed bright spots . . . . . Instars I-II .

2 (1). Plates on thoracic tergites heavily sclerotized, beset with numerous chalazae or setae and without an embryonic spine. Senti, parascoli, strumae or verrucae large, with numerous setae or chalazae (Fig. 17). If the verrucae are small, with one to three setae, the epicranial suture is absent. Larvae usually with bright spots. . . . . Instars III-IV.

KEY TO GENERA OF LARVAE OF TRIBE COCCINELLINI

Instars I-II

1 (2). Mandibles with three teeth (Fig. 20) . . . . . Bulaea Muls. (B. Lichatschovi Humm.)

2 (1). Mandibles with two teeth (Fig. 19).

3 (6). Abdominal tergites with small senti.

4 (5). Hind margin of tergite IX entire . . . . . Anatis Muls. (A. ocellata L.)

5 (4). Hind margin of tergite IX three-lobed . . . . . Calvia Muls. (C. 14-guttata L.)

6 (3). Abdominal tergites with parascoli, strumae or verrucae.

7 (8). Abdominal tergites with verrucae . . . . . Paramysia Rt. (P. oblongoguttata L.)

8 (7). Abdominal tergites with parascoli or strumae.

9 (10). Hind margin of tergite IX with a conical projection (Fig. 25) . . . . . Propylaea Muls. (P. 14-punctata L.)

10 (9). Hind margin of tergite IX without projection.

11 (16). Antennae with well-developed cupola-like third segment (Fig. 21).

12 (13). Tarsal claw with tooth at base (Fig. 28) . . . . . Semiadalia Crotch. (S. 11-notata Schneid.)

13 (12). Tooth at base of tarsal claw absent (Fig. 29).

14 (15). Parascoli sparsely beset with hairs . . . . . Adonia Muls. (A. variegata Goeze).

15 (14). Parascoli densely beset with hairs . . . . . Hippodamia Muls. (H. 13-punctata L.).

16 (11). Antennae with low, barely discernible third segment (Fig. 22).

17 (18). Abdominal tergites with strumae. . . . . Coccinula Dobr.

18 (17). Abdominal tergites with parascoli.

19 (20). Base of chalazae of elongate-cylindrical form (Fig. 3); if of roundly triangular form (Fig. 2), then dorsal parascoli only have two chalazae. . . . . Coccinella L.

20 (19). Base of chalazae of roundly triangular form, only a little taller than broad. Dorsal parascoli with more than two chalazae.

21 (22). Larvae with small pink or red spots . . . . . Synharmonia Gglb.

22 (21). Larvae have neither pink nor red spots . . . . . Adalia Muls.

Instars III-IV

1 (2). Mandibles with three teeth (Fig. 20). Base of strumae on abdominal tergites quadrate (Fig. 5). Tarsal claw without tooth at base. . . . . Bulaea Muls. (B. lichatschovi Humm.)

2 (1). Mandibles with two teeth (Fig. 19).

3 (6). Abdominal tergites with senti (Fig. 11).

4 (5). Senti on thoracic plates digitiform with one seta at apex. Outer margins of plates on meso- and metathorax with five senti (Fig. 23). Hind margin of tergite IX three-lobed . . . . . Calvia Muls. (C. 14-guttata L.).

5 (4). Senti on thoracic plates branched, with many setae (Fig. 11). Outer margins of plates on meso- and metathorax with one sentus (Fig. 24). Hind margin of tergite IX entire. . Anatis Muls. (A. ocellata L.)

6 (3). Abdominal tergites with verrucae, parascoli or strumae .

7 (8). Abdominal tergites with verrucae (Fig. 4). Hind margin of tergite IX three-lobed. . . . . Paramysia Rt. (P. oblongoguttata L.)

8 (7). Abdominal tergites with parascoli or strumae.

9 (10). Hind margin of tergite IX with conical projection (Fig. 25). Two plates on prothoracic tergites . . . . . Propylaea Muls. (P. 14-punctata L.).

10 (9). Hind margin of tergite IX without conical projection.

11 (16). Antennae high, second segment three times as long as first, third segment well developed, cupola-like (Fig. 21).

12 (13). Tarsal claw with tooth at base (Fig. 28). Parascoli on abdominal tergites with three large and several small chalazae. . . . . Semiadalia Crotch. (S. 11-notata Schneid.)

13 (12). Tooth at base of tarsal claw absent (Fig. 29).

14 (15). Dorsal parascoli small, with one very large and several smaller chalazae (Fig. 7), brown on abdominal segment IV. Bases of parascoli beset with dense, short hairs . Adonia Muls. (A. variegata Goeze).

15 (14). Dorsal parascoli digitiform with four large and several small chalazae (Fig. 8). All the parascoli on abdominal segment IV yellow. Bases of parascoli beset with dense and longer hairs . . . . . Hippodamia Muls. (H. 13-punctata L.).

16 (11). Antennae low, second segment one-and-a-half times as long as first, third segment very small, hard to distinguish (Fig. 22).

17 (20). On prothorax two semioval plates, occupying center of tergite.

18 (19). Plates of mesothoracic tergites roundly oval (Fig. 27). Abdominal tergites with strumae beset with numerous chalazae (Fig. 6). Larvae white or yellow with dark spots . Coccinula Dobr .

19 (18). Plates of mesothoracic tergites pyriform, considerably constricted on inner side (Fig. 26). Abdominal tergites with parascoli having two to three large chalazae. Larvae with pink or red spots . . . . . Synharmonia Gglb.

20 (17). On prothoracic tergites there are four longitudinal plates connected in pairs by more or less narrow crosspieces.

21 (22). Parascoli on abdominal tergites high, digitiform with approximately ten large chalazae (Fig. 10). If the parascoli are small, with two large chalazae (Fig. 9), then the tooth at base of tarsal claw is absent . . . . . Coccinella L.

22 (21). Parascoli on abdominal tergites small, with not more than five large chalazae. Tooth at base of tarsal claw well developed . . . . . Adalia Muls.

KEY TO SPECIES OF LARVAE OF TRIBE COCCINELLINI

Genus Coccinella L.

Instars I-II

1 (2). Bases of chalazae of roundly triangular form (Fig. 2). Dorsal parascoli with two large and one small chalazae. Larvae black with weakly developed yellow spots . . . . C. 11-punctata L.

2 (1). Bases of chalazae of cylindrical form (Fig. 3). Dorsal parascoli with four or more chalazae.

3 (4). Parascoli of abdominal tergites low, flat. Larvae black . . . . C. 7-punctata L.

4 (3). Parascoli of abdominal tergites higher, round (Fig. 16). Larvae grayish-yellow . . . . . C. divaricata Ol.

Instars III-IV

1 (2). Parascoli on abdominal tergites small, round, with three chalazae (Fig. 9). Tooth at base of tarsal claw absent or very weak. Larvae gray with yellow spots . . . . . C. 11-punctata L.

2 (1). Parascoli on abdominal tergites large, digitiform, with ten or more chalazae (Fig. 10). Tooth at base of tarsal claw well developed.

3 (4). On prothoracic tergites the lateral and median plates are connected by a narrow crosspiece. Outer margins of lateral plates of prothorax not raised and with about 20 chalazae . Larvae bluish-gray, pale, with orange and yellow spots . . . . . C. 7-punctata L.

4 (3). On prothoracic tergites lateral and median plates completely separated. Outer margins of lateral plates of prothorax raised and with about 30 chalazae. Larvae bluish-black, darker, with orange and yellow spots . . . . . C. divaricata Ol.

Genus Coccinula Dobr.

Instars I-II

1 (4). Inner hind angles of sclerotized plates on prothorax obliquely truncate.

2 (3). Larvae pale yellow, almost white, with pale brown spots. Dorsal and dorsolateral strumae of abdominal segment IV pale brown . . . . . C. elegantula Ws.

3 (2). Larvae yellow with brown spots. Dorsal and dorsolateral strumae of abdominal segement IV yellow. . . . . C. redimita Ws.

4 (1). Sclerotized plates on prothorax rectangular .

5 (6). Larvae pale yellow, almost white with gray or pale brown spots. Dorsal and dorsolateral strumae on abdominal segment IV dark . . . . . C. sinuatomarginata (Fald.)

6 (5). Larvae yellow with brown spots. Dorsal and dorsolateral strumae on abdominal segment IV yellow . . . . . C. 14-pustulata L.

Instars III-IV

1 (2). Larvae very slender, well-proportioned, white, with brown plates and strumae. Strumae on abdominal segment IV also brown. Other lateral margins of prothoracic plates with about ten chalazae . . . . . C. sinuatomarginata (Fald.).

2 (1). Larvae broader, yellow, with black plates and strumae. Strumae on abdominal segement IV yellow. Outer lateral margins of prothoracic plates with about 15 chalazae .

3 (4). Larvae bright yellow, almost orange, with black head. Prothoracic plates with deep rounded emargination on fore margin. Tibiae uniformly slender, approximately eight times as long as broad. . . . . C. redimita Ws.

4 (3). Larvae pale yellow, head yellow at front. Emargination on fore margin of prothoracic plates shallow. Tibiae dilated in middle and approximately five times as long as broad . . C. 14-pustulata L.

Genus Synharmonia Gglb.

Instars I-II

1 (2). Dorsal parascoli on abdominal tergites roundly oval with three chalazae close together. Larvae black with red spots between thoracic plates . . . . . S. oncina Ol.

2 (1). Dorsal parascoli on abdominal tergites elongate-oval with three chalazae spaced wide apart. Larvae black with gray or pinkish-gray spots between thoracic plates. . . . S. conglobata L.

Instars III-IV

1 (2). Margins of plates on prothoracic tergites more or less uniformly covered with chalazae. Larvae reddish-brown with distinct white and red spots, parascoli on pleurites red, white and black . . . . . S. oncina Ol.

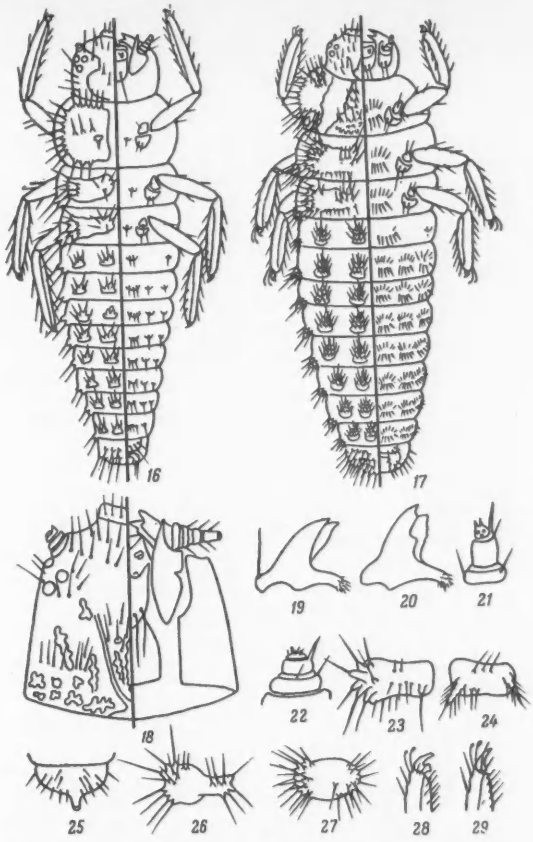


Fig. 16 - 29. Morphological features of larvae of tribe Coccinellini. 16) Instar I of Coccinella divaricata Ol.; 17) instar IV of C. divaricata Ol.; 18) head of Bulaea lichatschovi Humm.; 19) mandible of Synharmonia oncina Ol.; 20) mandible of B. lichatschovi Humm.; 21) antennae of Hippodamia 13-punctata L.; 22) antennae of Coccinula 14-pustulata L.; 23) mesothoracic plate of Calvia 14-guttata L.; 24) mesothoracic plate of Anatis ocellata L.; 25) tergite IX of Propylaea 14-punctata L.; 26) mesothoracic plate of S. oncina Ol.; 27) mesothoracic plate of Coccinula redimita Ws.; 28) tarsal claw of Semiadalia 11-notata Schneid.; 29) tarsal claw of H. 13-punctata L.

2 (1) Chalazae on prothoracic plates mainly on hind and hind-outer margins. Larvae pink with white spots, all parascoli on pleurites pinkish-cream . . . . . S. conglobata L.

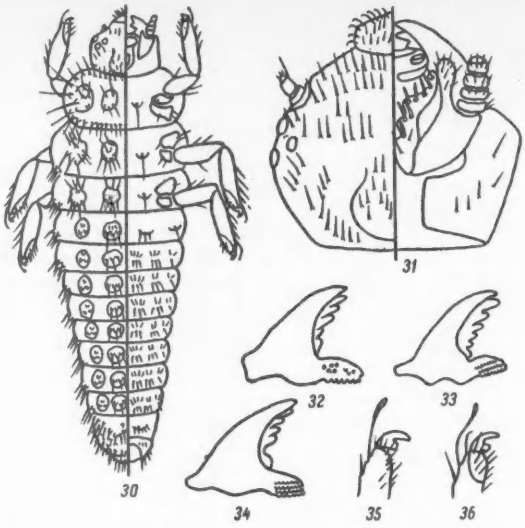
Genus Adalia Muls.
Instars III-IV

1 (2). Parascoli on abdominal tergites with five large chalazae at apex. Lateral parascoli yellow or white with black apex. . . . . A. bipunctata L.

2 (1). Parascoli of abdominal tergites with three large chalazae at apex. Lateral parascoli black. . . . . A. fasciatopunctata Fald.

KEY TO GENERA OF LARVAE
OF TRIBE PSYLLOBORINI
Instars I-II

1 (2). Submentum divided into two lobes (Fig. 31). Tooth at base of tarsal claw rectangular (Fig. 35) . . . . . Thea Muls. (Th. 22-puctata L.)



Figs. 30 - 36. Morphological features of larvae of tribe Psylloborini. 30) Instar IV of Halyzia tschitscherini Sem.; 31) head of Thea 22-punctata L.; 32) mandible of Th. 22-punctata L.; 33) mandible of H. tschitscherini Sem.; 34) mandible of Vibidia 12-guttata Poda; 35) tarsal claw of Th. 22-punctata L.; 36) tarsal claw of V. 12-guttata Poda.

2 (1). Submentum entire. Tooth at base of tarsal claw round (Fig. 36).
3 (4). Mandible with six teeth in addition to apical tooth (Fig. 33). Submentum with deep emargination in center . . . . . Halyzia Muls (H. tschitscherini Sem.)
4 (3). Mandible with five teeth in addition to apical tooth (Fig. 34). Submentum without central emargination . . . . . Vibidia Muls. (V. 12-guttata Poda)

Instars III-IV

1 (4). On prothoracic tergites four sclerotized plates. Dorsal and dorsolateral strumae on abdominal segement VIII brown, tergite IX with two brown strumae.
2 (3). Dorsal strumae oval, transversely produced, dorsolateral strumae round; the first with three large and several small chalazae. Mandible with five teeth in addition to apical tooth (Fig. 32). Tooth at base of tarsal claw rectangular (Fig. 35). . . . . Thea Muls (Th. 22-punctata L.)
3 (2). Dorsal strumae round, dorsolateral oval, produced longitudinally; the first with one large and several small chalazae. Tooth at base tarsal claw rounded. Mandible with six teeth in addition to apical tooth (Figs. 30, 33) . . . Halyzia Muls. (H. tschitscherini Sem.)
4 (1). Two sclerotized plates on prothoracic tergites. Dorsal and dorsolateral strumae on abdominal segment VIII yellow, tergite IX without strumae. Dorsal and dorsolateral strumae round. Mandible with five teeth in addition to apical tooth (Fig. 34). Tooth at base of tarsal claw rounded (Fig. 36). . . . . Vibidia Muls. (V. 12-guttata Poda).

KEY TO GENERA OF LARVAE OF TRIBE CHILOCORINI

Instars I-II

1 (2). Epicranial stem well developed, mandibles with two teeth (Fig. 38). . . . . Chilocorus Leach. (Ch. bipustulatus L.)
2 (1). Epicranial stem absent, mandibles with one tooth (Fig. 39).
3 (4). Dorsolateral senti with three setae . . . . . Brumus Muls.
4 (3). Dorsolateral senti with two setae . . . . . Exochomus Rebtb.

Instars III-IV

1 (2). Epicranial stem well developed. Mandible with two teeth at apex (Fig. 38). No sclerotized plates on tergites of meso- and metathorax. Senti six times as long as broad (Fig. 40). Tooth at base of tarsal claw with a hooklike appendage (Fig. 42). Larvae grayish-white with brown senti . . . . . Chilocorus Leach. (Ch. bipustulatus L.)
2 (1). Epicranial stem absent. Mandible with one tooth at apex (Fig. 39). Sclerotized plates on tergites of meso- and metathorax. Senti three to four times longer than broad (Fig. 41).

3 (4). Four sclerotized plates on prothoracic tergites. Senti on last abdominal segments three times as long as broad. Larvae orange or grayish-brown with brown plate and senti. . Brumus Muls.

4 (3). Two more or less sclerotized plates on prothoracic tergites. Senti on last abdominal segments four times as long as broad (Fig. 41). Larvae grayish-yellow or cream with brown plates and senti. . . . . Exochomus Redtb.

KEY TO SPECIES OF LARVAE OF TRIBE CHILOCORINI

Genus Brumus Muls.

Instars III-IV

1 (2). Lateral and median plates on prothoracic tergites completely separated. Outer margins of plates of meso- and metathorax with senti. Larvae orange with black and brown senti (Fig. 37). . . . . B. 8-signatus Gebl.

2 (1). Lateral and median plates of prothorax connected at fore margin of tergite. Ourter margins of plates of meso- and metathorax with chalazae. Larvae grayish-brown with brown plates and senti. . . . . B. jacobsoni Bar.

Genus Exochomus Redtb.

Instars I-II

1 (2). Tooth at base of tarsal claw absent (Fig. 43). . . . . E. semenovi Ws.

2 (1). Tooth at base of tarsal claw present.

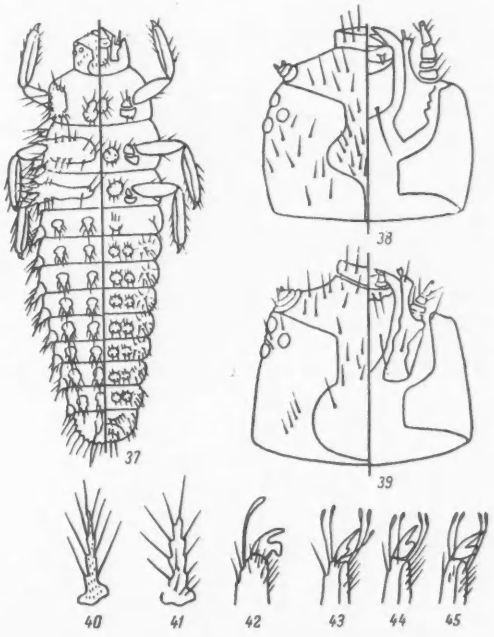
3 (4). Tooth at base of tarsal claw longer than broad (Fig. 44). . E. melanocephalus Zubk.

4 (3). Tooth at base of tarsal claw broader than long (Fig. 45). . E. flavipes Thunb.

Instars III-IV

1 (2). Tooth at base of tarsal claw absent (Fig. 43). Plates on thoracic tergites completely sclerotized. Larvae grayish-yellow with black plates and senti . . . . . E. semenovi Ws.

2 (1). Tooth at base of tarsal claw present. Plates on thoracic tergites only sclerotized on margins. Larvae paler, cream.



Figs. 37 - 45. Morphological features of larvae of tribe Chilocorini. 37) Instar IV of Brumus 8-signatus Gebl.; 38) head of Chilocorus bipustulatus L.; 39) head of Exochomus melanocephalus Zubk.; 40) sentus of Ch. bipustulatus L.; 41) sentus of E. melanocephalus Zubk.; 42) tarsal claw of Ch. bipustulatus L.; 43) tarsal claw of Exochomus semenovi Ws.; 44) tarsal claw of E. melanocephalus Zubk.; 45) tarsal claw of Exochomus flavipes Thunb.

3 (4). Tibia twice as long as dorsal senti on abdominal segment VIII. Tooth at base of tarsal claw longer than broad (Fig. 44) . . . . . E. melanocephalus Zubk.

4 (3). Tibia one-and-a-half times as long as dorsal senti on abdominal segment VIII. Tooth at base of tarsal claw broader than long (Fig. 45) . . . . . E. flavipes Thunb.

Keys are not given for larvae of the tribes Stethorini, Scymnini and Hyperaspidini, since in each of these tribes we examined only one or two species : Stethorus punctillum Ws. (Tribe Stethorini), Scymnus frontalis Fabr., Sidis sp. (tribe Scymnini) and Oxynychus sp. (tribe Hyperaspidini).

SUMMARY

The author studied the morphology of the ladybirds' larvae (Coleoptera, Coccinellidae) of 32 species from Southeast Kazakhstan; the key is included herein.

It has been established that considerable age changes are characteristic of the Coccinellidae larvae. Taking into consideration these peculiarities, the larvae can be welded into two groups : larvae I-II are referred to as the 1st group, larvae III-IV as the 2nd one. Within the limits of the groups no considerable difference in the structure appears to be found; the distinctions between groups are more pronounced. The most sharp difference lies chiefly in coloration, comparative dimensions of different body sclerites, and in larvae chaetotaxy, in particular. On the contrary, the structure of mouth organs does not undergo considerable changes.

The key to the tribes of larvae is worked out by the author by means of the characters not undergoing age changes, hence available for determination the larvae of any age. At examination of genera and tribes of the Coccinellidae the peculiarities of chaetotaxy, changing throughout the larval development, were taken into account.

That is why in this paper there are both generic and specific keys on young (I-II) and old (III-IV) ages respectively. The key for determination of the age of larvae precedes the two mentioned above. However, while determining the genera, the characters not undergoing the age changes were used, if possible.

In the paper the keys for determination of the larvae of the following genera are given : Bulaea Muls., Anatis Muls., Calvia Muls., Paramysia Rt., Propylaea Muls., Semiadalia Crotch., Adonia Muls., Hippodamia Muls., Coccinula Dobr., Coccinella L., Synharmonia Gglb., Adalia Muls. (the tribe Coccinellini); Thea Muls., Vibidia Muls., Halyzia Muls. (the tribe Psylloborini); Chilocorus Leach., Exochomus Redtb., Brumus Muls. (the tribe Chilocorini).

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TAXONOMY AND ECOLOGY OF THE PELOPIINAE (DIPTERA, TENDIPEDIDAE) OF UCHINSK RESERVOIR. II. PELOPIA, ABLABESMYIA, AND CLINOTANYPUS

T. A. Koreneva

Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 1, pp. 134-143, January-March, 1960

During the period 1954-1958 we were occupied with a study of the taxonomy and ecology of the Pelopiinae of Uchinsk Reservoir. From the results of these investigations the following material was published: description of egg batches and egg-laying sites (Koreneva [1959a]); description of first-instar larvae (Koreneva [1959 b]); description of fourth-instar larvae, pupae and imagines of Procladius and Psilotanypus (Muragina-Koreneva[1957]) and an account of the life cycles (Sokolova and Koreneva [1959]).

The present paper gives descriptions of the fourth-instar larvae, pupae and imagines of two species of Pelopia, two species of Ablabesmyia and one species of Clinotanypus. As distinct from Procladius and Psilotanypus the listed species dwell mainly in the littoral zone at a depth not exceeding 5 m.

KEY TO SPECIES OF GENUS PELOPIA

Larvae

1 (2). Paralabial comb with six yellow denticles, the lateral ones being largest. Paralinguae with many slender projections on lateral margin. Two pairs of anal papillae . . . . . Pelopia vilipennis Kieff.

2 (1). Paralabial comb with six brown denticles of equal size. Paralinguae biapical, with serrated lateral margin. Three pairs of anal papillae. . . . . Pelopia punctipennis Mg.

Pupae

1 (2). Lateral margins of abdominal segments III-VI bare. Six bristles on each lateral margin of segment VII, five bristles on each lateral margin of segment VIII (Fig. 1,B). . . . . Pelopia vilipennis Kieff.

2 (1). Lateral margins of abdominal segments III-VIII invested with dense soft hairs (Fig. 1, A). . . . . Pelopia punctipennis Mg.

Imagines (males)

1 (2). Wings with two distinct greyish spots in region of anal cell and one black spot in region of vein r-m. End of gonostyle not drawn into a spine at base of sclerotized point. Five to ten broad daggerlike bristles at base of gonocoxite (Fig. 2, A) . . . . . Pelopia vilipennis Kieff.

2 (1). Wings with numerous dark-gray round spots. End of gonostyle drawn into a spine at base of sclerotized point. 15-20 broad daggerlike bristles at base of gonocoxite (Fig. 2, B). . . . . Pelopia punctipennis Mg.

Pelopia vilipennis Kieff. (1918)

The larvae from Uchinsk Reservoir agree fully with the descriptions (Gouin [1936]) and figures (Chernovskii [1949]) in the literature. The paralabial combs have six pale-yellow blunt denticles, the lateral denticles being larger than the others. The paralinguae have many slender projections on the lateral margin. The last abdominal segment has two pairs of anal papillae. The larva is greenish, and 8-9 mm long.

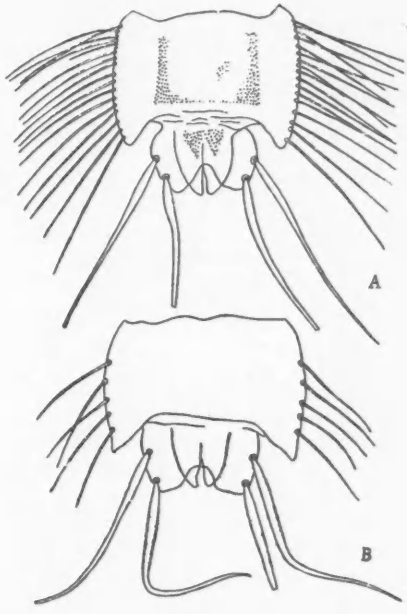

Fig. 1. Last abdominal segment and anal fin of pupa. A) Pelopia punctipennis Mg.; B) P. vilipennis Kieff.

The pupae, both those collected in the reservoir and those bred out from larvae, agree completely with Gouin's description [1936]. The pupal exuviae are pale and transparent. The mesonotum is suffused with brown. The lateral margins of abdominal segments I to VI are bare. There are six bristles on each lateral margin of segment VII, and on each lateral margin of segment VIII there are five bristles, the length of these being half the width of the segment. The anal fin is rudimentary: in the males it is a little shorter than the sheaths of the sexual appendages. There are two broad long bristles on each lateral margin of the anal fin (Fig. 1, B).

The imagines, both those collected on the shores of the reservoir and those bred out from larvae, agree fully with Goetghebuer's description [1936]. In addition, we should mention that in specimens from Uchinsk Reservoir the gonostyle is shaped like an elephant's tusk and terminates in a sclerotized point; the end of the gonostyle at the base of the point is not drawn into a spine, and at the base of the gonocoxite there are five to ten broad, daggerlike bristles (Fig. 2, A).

Ecology. A few specimens of larvae at the point of pupation were found at depth 2-3 m in Lodochnyi Bay in mid-June. The emergence of the imagines takes place in late June. We did not observe swarming of the imagines. The females shed their egg batches in the bay.

The identity of the larvae, pupae and imagines from Uchinsk Reservoir was established by breeding out the imagines from the larvae.

The species is recorded from England, Austria, Hungary, and Belgium.

Pelopia punctipennis Mg. (1818)

The larvae from Uchinsk Reservoir differ from those described by Thienemann and Zavrel [1919] and resemble the larvae of P. kraatzi described by the same authors. The labium of the larva has six blunt, brown denticles of equal size; the biapical paraglossae are serrated on the lateral margin (Fig. 3); the last abdominal segment has three pairs of anal papillae; the larvae are yellowish-green, 10-12 mm in length.

The pupae, collected from the reservoir and bred out from larvae, are similar to the pupa of P. punctipennis Mg. described by Thienemann and Zavrel [1919], and differ from the pupae described by Johannsen [1937] and Shilova [1953] for this species. The pupal exuviae are pale, transparent; the antennal sheaths are pale; the mesonotum is suffused with brown; a pair of large diffuse spots are located on abdominal tergites II-VIII; the lateral margins of abdominal segments I and II are bare; the lateral margins of abdominal segments III-VIII are invested with dense soft hairs; the length of the hairs on abdominal segment III is one-sixth of its width; the length of the hairs on abdominal segment VIII is equal to its width; the anal fin is rudimentary--in the males it is a little shorter than the sheaths of the sexual appendages; there are two broad long bristles on the lateral margins of the anal fin (Fig. 1, A).

Imagines collected on the shores of the reservoir and bred out from larvae do not differ from the imagines of P. punctipennis Mg. described by Goetghebuer [1936] nor from the imagines of this species described by Shilova [1953] from the Amu-Dar'ya region. In Shilova's work [1953] the illustration of the hypopygium shows 15-20 broad daggerlike bristles at the base of the gonocoxite and the end of the gonostyle is drawn out into a spine near the base of the point. These details of structure are typical also of the imagines from Uchinsk Reservoir. Since the larvae of our species differ from the larvae of Pelopia punctipennis Mg. described by other authors, we

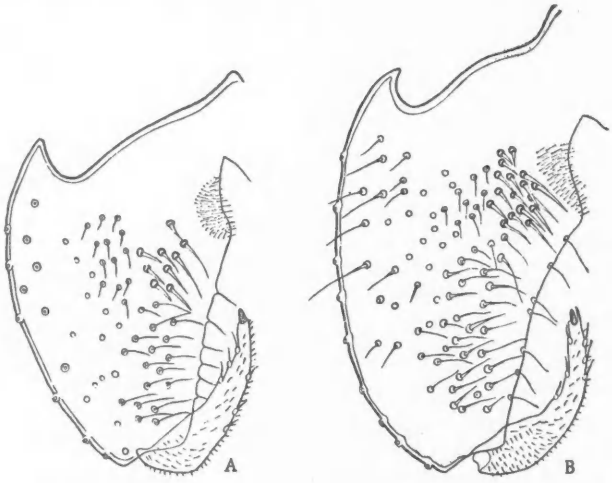

Fig. 2. Basal segment of hypopygium and gonostyle. A) Pelopia vilipennis Kieff.; B) P. punctipennis Mg.

give a full description of the imagines bred out from larvae from Uchinsk reservoir or collected on its shores.

Mouth parts pale brown; 1st segment of antennae dark brown; remaining antennal segments pale brown; pronotum pale brown, with a furrow along median line; mesonotum pale brown with black longitudinal stripes, and covered with silvery scales; metanotum blackish-brown; halteres with gray stalk and white lobe; legs pale yellow; articulations of fore femur and tibia with a dark crossband above and below; ends of tibia and 1st segment of fore tarsus, and also remaining segments of tarsus, dark; fore tarsus invested with hairs which are four to five times longer than width of segment; ratio of length of tibia to length of 1st segment of fore tarsus = 0.83-0.86; abdominal tergites dark brown, covered with silvery scales; wings transparent, colorless; numerous round spots scattered over whole surface of wing; similar spots also in region of veins r-m and fork of veins R_2 and R_3; wing surface pilose distally; veins r-m and m-cu dark; gonostyle shaped like an elephant's tusk and terminating in sclerotized point; end of gonostyle near point drawn into a spine; 15-20 broad, daggerlike, brown bristles at base of gonocoxite (Fig. 2, B). Body length 4 mm.

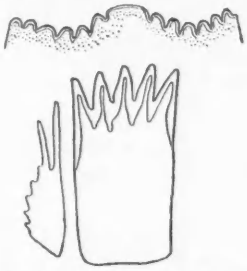

Fig. 3. Paralabial combs, lingua and paralinguae of larva of Pelopia punctipennis Mg.

Ecology . The larvae dwell at depth 0.5-3 m in Lodochnyi Bay. Emergence of the imagines takes place in the first half of July. We did not observe swarming of the males. The females shed their egg batches into Lodochnyi Bay. In Uchinsk Reservoir the species had one generation in the year. The identity of the larvae, pupae and imagines from Uchinsk Reservoir was established by rearing imagines from larvae collected in the reservoir. The table summarizes the differences between the larvae and pupae determined from bred-out imagines as P. punctipennis Mg. by different authors. Since all these authors ensured the identity of the larvae, pupae and imagines by breeding-out, we cannot only suggest that the larvae and pupae they described are of different species, for which no differences have yet been found in the imaginal stage.

The species is known from Germany, England, Austria, Belgium, France, Holland, Hungary, Finland, and Scandinavia.

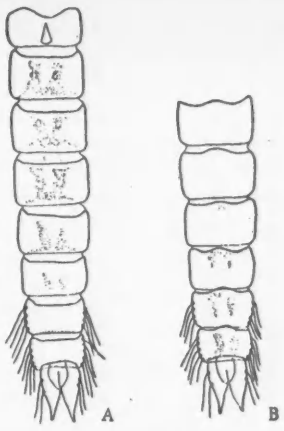

Fig. 4. Abdominal segments of pupal exuviae of Ablabesmyia monilis L. A) Tergites; B) sternites

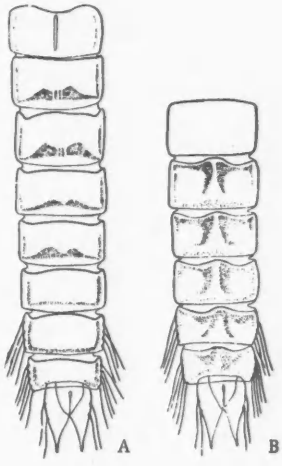

Fig. 5. Abdominal segments of pupal exuviae of Ablabesmyia phatta Egg. A) Tergites; B) sternites.

KEY TO SPECIES OF GENUS ABLABESMYIA

Larvae

1 (2). Unfixed larva pale yellow, mottled with reddish-brown spots. Width of lingua 0.060-0.066 mm. . . . . Ablabesmyia monilis L.

2 (1). Unfixed larva bright green. Width of lingua 0.075-0.076 mm. . . . . Ablabesmyia phatta Egg.

Pupae

1 (2). Mark on abdominal tergite I broad, triangular. Pattern of abdominal tergites and sternites as in Fig. 4. . . . . Ablabesmyia monilis L.

Comparison of Characters of Larvae and Pupae Determined from the Imagines as Pelopia punctipennis Mg. by Different Authors

Species from imago	Number of labial denticles and structure of paralinguae in larvae	Arrangement of hairs and bristles on lateral margins of abdominal segments of pupae	Author
P. bifurcatus Kieff. (syn. P. punctipennis Mg.).	Paralabial combs with eight pale denticles. Paralinguae with many slender projections on lateral margin.	Lateral margins of abdominal segments invested with dense soft hairs.	Thienemann and Zavrel (1921), Chernovskii (1949).
P. punctipennis Mg.	Paralabial combs with eight pale denticles. Paralinguae with 12-14 slender projections on lateral margins.	Lateral margins of abdominal segments invested with dense soft hairs. Lateral margins of segment VIII possessing, in addition, four long bristles each.	Johannsen (1937).
P. punctipennis Mg.	Paralabial combs with six yellow or brown denticles. Paralinguae with serrated lateral margins.	Lateral margins of abdominal segments I-VI bare. Lateral margins of segment VII bear six bristles each, margins of segment VIII five bristles each.	Shilova
P. punctipennis Mg.	Paralabial combs with six brown denticles. Paralinguae biapical with serrated lateral margin.	Lateral margins of abdominal segments densely invested with soft hairs.	Larvae from Uchinsk Reservoir.
P. kraatzi Kieff.	Paralabial combs with six brown denticles. Paralinguae biapical with serrated lateral margin.	Lateral margins of abdominal segments I to VI bare. Margins of segment VII bear six bristles each, margins of segment VIII five bristles each	Thienemann and Zavrel (1921).

2 (1). Mark on abdominal tergite I long and narrow. Pattern of abdominal tergites and sternites as in Fig. 5 . . . . . Ablabesmyia phatta Egg.

Imagines (males)

1 (2). Bristle on end of gonostyle funnel-shaped (Fig. 6, B). Aedeagus in Fig. 7. Length of pilosity of fore tarsus not more than twice width of segment . . . . . Ablabesmyia monilis L.

2 (1). Bristle on end of gonostyle simple, pointed (Fig. 6, A). Aedeagus in Fig. 10. Length of pilosity of fore tarsus five to six times greater than width of segment . . . . . Ablabesmyia phatta Egg.

Ablabesmyia monilis L. 1763 (1761)

The larva from Uchinsk Reservoir agrees completely with the description given by Thienemann and Zavrel [1919]. Live larvae of this species have a characteristic striped pattern — reddish-brown patches on a yellow ground. Width of lingua 0.060-0.066 mm.

The pupa from Uchinsk Reservoir agrees fully with the description given by Thienemann and Zavrel [1919]. Characteristic of pupae of this species is the shape of the mark on abdominal tergite I and the pattern of the exuviae; the mark is distally dilated and has a triangular form. On tergites II-V there are pairs of diffuse brown spots, with

small colorless spots standing out against them. In the distal part of tergite VI there is a pair of indistinct brown spots. On tergites VII and VIII the spots are absent. On sternites I-IV the spots are also absent. On sternites V-VIII there is a pair of brown diffuse spots, which become larger and more distinct towards the tail of the pupa (Fig. 4).

The imagines (males and females), collected on the shores of the reservoir, and reared from larvae, agree completely with the descriptions in the literature (Goetghebuer [1937]). Characteristic features of the imago of this species are : the short pilosity of the fore tarsus, the shape of the bristle on the end of the gonostyle, and the structure of the aedeagus. The bristle at the end of the gonostyle is funnel-shaped, as shown in Johannsen's figure [1946] and Goetghebuer's figure [1927]. The structure of the aedeagus was first noted by Johannsen [1946]. The structure of the aedeagus in specimens from Uchinsk Reservoir agrees completely with Johannsen's figure [1946]. The length of the hairs on the fore tarsus is not more than twice the width of the segment.

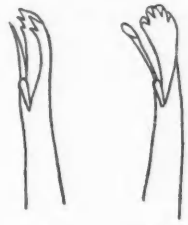

Fig. 6. Gonostyle. A) Ablabesmyia phatta Egg; B) A. monilis L.

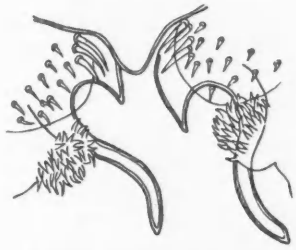

Fig. 7. Aedeagus of Ablabesmyia monilis L.

Ecology . The larvae dwell on the bottom in the zone of the littoral beds of Potamogeton and Elodea, where the depth does not exceed 5 m. The first emergence of the imagines takes place in late June, and the second at the end of August. The swarming of the males is loose and formless, and usually takes place at a height of 0.5 to 1.0 m on the lee side of bushes. The females attach their egg batches to aquatic plants. In the egg batches of this species we first discovered parasitic rotifers (Koreneva [1958]). In the reservoir this species has two generations in the year.

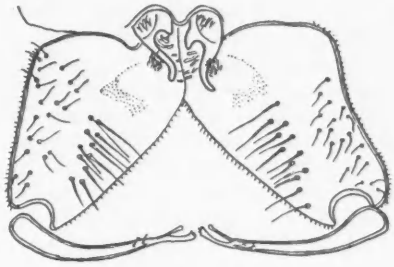

Fig. 8. Hypopygium of Ablabesmyia monilis L.

Fig. 9. Shape of hooks on hind prolegs of larva of Ablabesmyia phatta Egg.

The identity of the larvae, pupae and imagines from Uchinsk Reservoir was established by rearing imagines from the larvae.

The species A. monilis is very close to A. phatta both in the coloration of the imago and in the structure of the larvae and pupae. It differs from the latter species in the short pilosity of the fore tarsus and the structure of the genitalia in the imaginal phase, the pattern of the exuviae of the pupal phase, and the narrower lingua and coloration of the live larvae.

The species is known from Germany, Hungary, England, Belgium, Holland, Finland, and Sweden. Grandilevskaya-Deksbakh [1931] and Shilova [1953] have recorded it for the USSR.

Ablabesmyia phatta Egg. (1863)

The larva does not differ in structure from the larva of A. monilis. The head capsule of the larva is pale yellow, the occipital sclerite dark brown; the antennal ratio is 5 : 1; the broad bristle on the 1st antennal segment has a small secondary bristle; the annular organ is located in the middle of the 1st segment; the 2nd bears

a pair of small Lauterborn organs; the mandible has a large black terminal tooth and two pale lateral, secondary denticles; the maxilla has a two-segmented palp; the 1st segment of the maxillary palp consist of three or four more heavily sclerotized rings, alternating with more slender membranous regions; the annular organ of the maxilla is situated in the membranous part between the 1st and 2nd segment; the free margin of the maxillary lobe bears a dense series of tumid bristles; the lingua has five black teeth, the middle one of these being smallest; the apices of the teeth form a curved line; the width of the lingua is 0.075-0.076 mm; the paralinguae are biapical, the median apex much lower; the well-developed transverse combs of the hypopharynx consist of 15-20 teeth; the hooks of the hind prolegs have smooth margins; two hooks of the hind prolegs are dark brown, the remainder are pale yellow; one hook differs from the rest in its smaller size and distinctive beaklike shape (Fig. 9); at the distal part of the proleg there is a small group of spinules near the fan of hooks; the larva is emerald-green, 10-11 mm in length.

This is the first description of the larva.

In structure the pupa is indistinguishable from A. monilis. The antennal sheaths are pale yellow; the mesonotum is covered with amorphous brown spots; the respiratory organ is oval, dark; the mark on abdominal tergite I is long and narrow; the fore margins of the abdominal segments are slightly darkened and do not stand out so clearly as in the pupa of A. monilis; in the distal half of tergites II-V there is a pair of brown diffuse spots; on tergites VI-VIII the spots are absent; on sternites I to III there are no spots; on sternites IV-VIII there is a pair of diffuse brown spots; the lateral margins of segments I-VI are bare; there are four bristles on each lateral margin of segment VII, and five on each lateral margin of segment VIII; the lobes of the anal fin are well developed, triangular and drawn into a long point at the apex; there are two bristles on the lateral margins of the lobes (Fig. 5); length of pupa 7.5 mm.

This is the first description of the pupa.

The imagines collected on the shores of the reservoir, as well as those bred out from larvae, agree completely with Goetghebuer's description [1936]. Specimens from Uchinsk Reservoir have a simple gonostyle bristle (Fig. 6, A) and aedeagus, shown in Fig. 10. The fore tarsus is densely invested with hairs, the length of these being five to six times the width of the segment.

Ecology. We did not observe swarming of the imagines or egg-laying. Larvae ready to pupate were found in Elodea and Potamogeton beds in the first half of August.

The identity of the larvae, pupae and imagines from Uchinsk Reservoir was established by rearing the imagines from larvae. The species A. phatta is very close to A. monilis both in the coloration of the imago, and in the structure of the larva and pupa; it differs from the latter in the long pilosity of the fore tarsus and the structure of the genitalia in the imaginal phase, the pattern of the exuviae in the pupal phase, and the narrower lingua and distinctive coloration of the live larvae.

The species is known from Germany, Hungary, England, Belgium, and Finland.

Clinotanypus nervosus Mg. (1818)

The larva, pupa and imago from Uchinsk Reservoir agree completely with the descriptions in the literature (Goetghebuer [1936]; Thienemann and Zavrel [1921]).

Ecology. The larvae dwell on the bottom in beds of Typha, where the depth does not exceed 1 m. A mass emergence of the imagines takes place in July. The swarming of the males is loose, formless, and takes place at a height of 2-3 m. The females shed their egg batches among Typha stems in the littoral zone. In the reservoir the species has one generation during the year.

The species is known from France, Belgium, Germany, England, Hungary, Austria, Scandinavia, Holland, and Finland.

Some species of Peloplinae which we have examined in one or two phases of their metamorphosis do not differ from one another in their structure. For instance, the

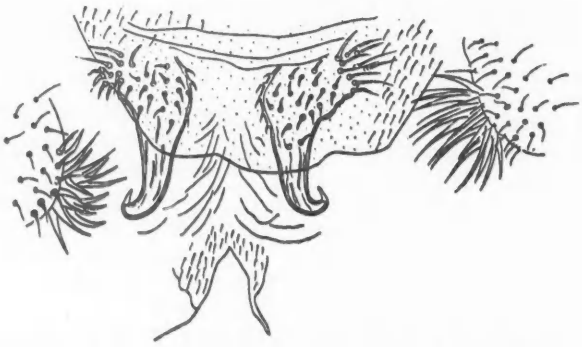

Fig. 10. Aedeagus of Ablabesmyia phatta Egg.

larvae and pupae of A. monilis L. and Procladius choreus Mg. are indistinguishable in structure from the larvae and pupae of A. phatta Egg. and Pr. nigriventris Kieff. The structure of the pupa of Pr. ferrugineus Kieff. does not differ in structure from that of Pr. choreus Mg. and Pr. nigriventris Kieff., while the larva of Pr. ferrugineus Kieff. differs from that of the latter two species in the smaller number of teeth on the labium (Muragina-Koreneva [1957]). In the imaginal phase these species are easily distinguished from one another by their structure, especially the structure of the genitalia, and this is obviously of some significance for the reproductive isolation of these species, the imagines of which are found in the field at the same time.

The biochemical and physiological dissimilarity of these species at morphologically similar phases of metamorphosis is indicated by their difference in coloration; in larvae of Pr. choreus Mg. and Pr. nigriventris Kieff.-in the color of the mouthparts; in larvae of A. phatta Egg. and A. monilis L.-in the body coloration during life; in pupae A. monilis L., Pr. choreus Mg. and A. phatta Egg. Pr. nigriventris Kieff.— in the color of the exuviae.

The same structure of the larvae and pupae of the species listed is evidently due to their similar mode of life. The larvae of Pr. choreus Mg., Pr. nigriventris Kieff. and Pr. ferrugineus Kieff generally inhabit the same zone of the Uchinsk reservoir, and all three species feed on the same food. Moreover, the females of these species deposit their egg batches in the same parts of the reservoir, and the egg batches of these species are practically indistinguishable from one another in their structure (Koreneva [1959 a]). The larvae and pupae of A. monilis L. and A. phatta Egg. are associated with Elodea and Potamogeton beds.

Species which are easily differentiated by their structure in the larval and pupal phase are also easily distinguished by their ecology. For instance, species of Ablabesmyia, Pelopia and Procladius are easily distinguished from one another both morphologically and ecologically. Species of Psilotanypus imicola Kieff. and Ps. rufovittatus v.d. Wulp. which are easily separated from one another by the structure of the larvae, pupae and imagines, have different larval habitats, different times of emergence (Muragina-Koreneva [1957]) and egg batches of different structure (Koreneva [1959 a]).

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PECULIARITIES OF THE SOIL-INHABITING LARVAE OF THE RHAGIONIDAE, DOLICHOPODIDAE AND EMPIDAE (DIPTERA).

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The aim of the present work is to describe the characteristic external morphology of larvae from three families of the Brachycera Orthorrhapha: the Rhagionidae, Dolichopodidae and Empedidae. Soil-inhabiting larvae of flies belonging to these families have many features in common, e.g., they are all carnivorous, highly mobile forms, which live in an environment characterized by its uniformity of conditions. The larvae of these three families not only lead a similar kind of existence but they are similar in appearance which renders their identification difficult. Thus, the basic criteria for distinguishing the families Empedidae and Dolichopodidae are the structural details of the head and of the last abdominal segment (Hennig [1952]). But among the Dolichopodidae there are forms (e.g., the genus Neurogona) in which the anal segment is very similar to that of larval Empididae. Within the limits of each family, there are considerable differences between the various genera and species, despite the general similarity between larval representatives of these families, both in their way of life and in their general morphology. Soil-inhabiting forms include representatives from dry soils and those from wet soils near the banks of rivers or other places of water (in the latter category are species of the genus Atherix among the Rhagionidae and species of the genus Atalanta among the Empididae). The majority of the larval Dolichopodidae are hygrophilous forms and therefore restricted to rather wet soils. Furthermore, most larvae belonging to this family show clearly defined preferences for particular ecological conditions and hence they are useful indicators of conditions prevailing in a given habitat (Shtakel'berg [1947]).

The larvae of these three families share, to a considerable extent, the characteristics common to all Cyclorrhaphid larvae.

The material on which our research is based is that collected by M. S. Gilyarov, during 1944-57, from different regions of the USSR (but principally from Southeastern European territory), and deposited in the collection of the Soil Zoology Laboratory, Institute of Animal Morphology, Academy of Sciences USSR. An investigation of this material enabled us to throw some light on the relationship between the morphological peculiarities of larvae belonging to the above-mentioned three families and their habitats in the soil.

Description of Larval Morphology

Detailed descriptions of the morphology of larvae belonging to the three families in question are at the present time nonexistent. Published work by most earlier writers in this field (Beling [1875, 1882, 1888]; Coquillett, [1883] and others) is usually devoid of illustrations or figures and contributes but little to our knowledge of the larvae belonging to these families. In somewhat later works (Malloch [1917]; de Meijere [1917]) the descriptions given are more detailed, and accurate diagrams are included. It was not, however, until comparatively recently that papers have been published, in which the detailed anatomy of various parts of the body of these larvae is given (Schremmer [1951]). Similar data relating to dipterous larvae of these particular groups have been given by Hennig [1952].

The material which was available to the author, enabled her to make accurate descriptions of representative larvae belonging to the families in question. The soil-inhabiting larvae of these families are characterized by having many features in common. Their bodies are elongate, slightly narrowing towards the head end and expanded posteriorly (Fig. 1, 1-4). The ventral surface bears small ridges, each supporting rows of tubercles; in some species there are processes and outgrowths on all the segment except the anal, while in others these structures are absent. The spiracles are amphipneustic in their arrangement; the posterior spiracles, situated on the end of the terminal segment are well developed. The head capsule is reduced and there is a noticeable tendency for the mouth parts to fuse together.

Family Rhagionidae. The soil-inhabiting larvae of the subfamily Rhagioninae are of uniform appearance but differ markedly from members of the subfamily Vermileoninae, whose way of life is similar to that of antlion larvae or amphibiotic larvae of the genus Atherix.

Rhagio. Larvae of this genus were collected from hollows in damp meadows (Mikhnevskii district, Moscow Region) during June, 1944.

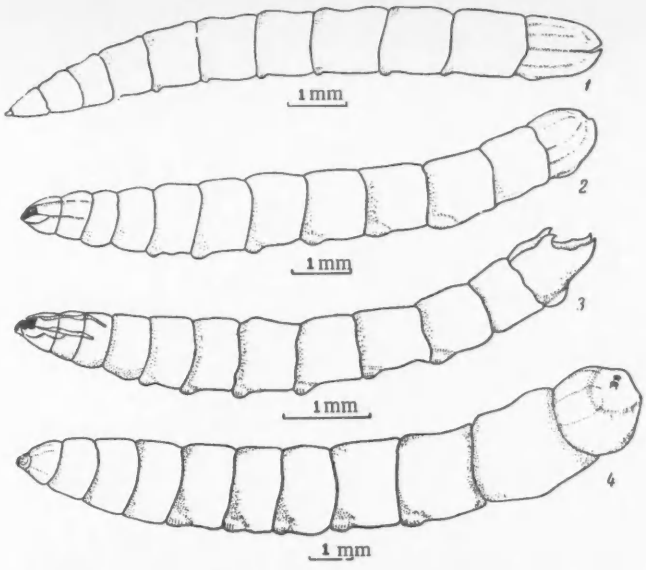

Fig. 1. General view of larvae. 1) Rhagio (Rhagionidae); 2) and 3) Neurogona, Medetera (Dolichopodidae); 4) Empididae.

In the genus Rhagio, as in the family Rhagionidae as a whole, the head capsule is retained in the form of a dorsal plate, the fronto-clypeus (Fig. 2, 1), which extends back as far as the mesothorax and covers the tentorial processes. The metacephalic processes are absent. The mandibles and maxillae are fused (c.f. Bischoff, [1925]. The mandibles are represented by tooth-like distal members, which form a moveable articulation with the basal sclerite (Figs. 2, 4). In larval Rhagio, the basal sclerite is in the form of a broad plate, the inner side of which lies parallel with the mid-line of the body; its ventral margin is serrate.* Because of its greater sclerotinization, the serrate ventral margin of this plate appears to be distinct from the rest of the sclerite. Certain authors, e.g., Schremmer [1951], consider the basal sclerite to belong to the mandible. The maxillae lie to the side of the mandibles. They consist of several elements, including a well-developed, two-jointed palp (Fig. 2, 1-4). The lacinia closely adjoins the basal sclerite and has a peculiar groove. By the side of the lacinia, there is the short galea, which bears on its ventral ma.gin short conical teeth. Adjacent to the galea, at the base of the palp, is a sclerite which Schremmer regards as the stipes. The wide base of the maxillary palp is prolonged as a soft membranous extension along the lateral wall of the mandible. The labrum is in the form of a large hook-like process – the rostrum. The antennae are two-jointed; the first joint is large, the second is very small and bears a few papillae. Because of the large size of its palps and antennae, the head end of Rhagionid larvae has a characteristic form (c.f. Fig. 2, 1).

The body of soil-inhabiting larvae of the subfamily Rhagioninae is devoid of any apparent appendages. The anterior abdominal segments of Rhagio larvae possess flanges on their ventral surfaces; these flanges are at right angles to the main axis of the body (Fig. 4, 1 and 2) and, at a certain distance from the mid-line, they are intersected by longitudinal furrows. The flanges are densely covered with slender setae.

The last body segment of larval Rhagionidae is exceedingly uniform in structure. It is most frequently characterized by the presence of four well-developed, equal lobes which arise from the edge of the stigmatal field (Fig. 5, 1: Rhagio larva, collected among litter in an oak wood, Goryachnii Springs, Krasnodarsk District, Aug. 5, 1955). These lobes may close up the stigmatal field in the same way as do similar outgrowths in Tipulid larvae. In certain members of the Rhagioninae the number of lobes may be greater than in Rhagio (Fig. 5, 2: Chrysopilus larva, collected in a ravine of the River Chumakovka, Georgievskii Forest, Krasnodarsk District, May 22, 1954). The lobes may be sclerotinized (Fig. 5, 5: Symphoromyia larva, collected in the soil of a walnut wood, Kara-Alma, Ferganskii Mountains, July 10, 1945). In this latter case the stigmatal field cannot, of course, be closed off.

* In the closely related genus Chrysopilus the basal sclerite is devoid of serration (Schremmer [1951]).

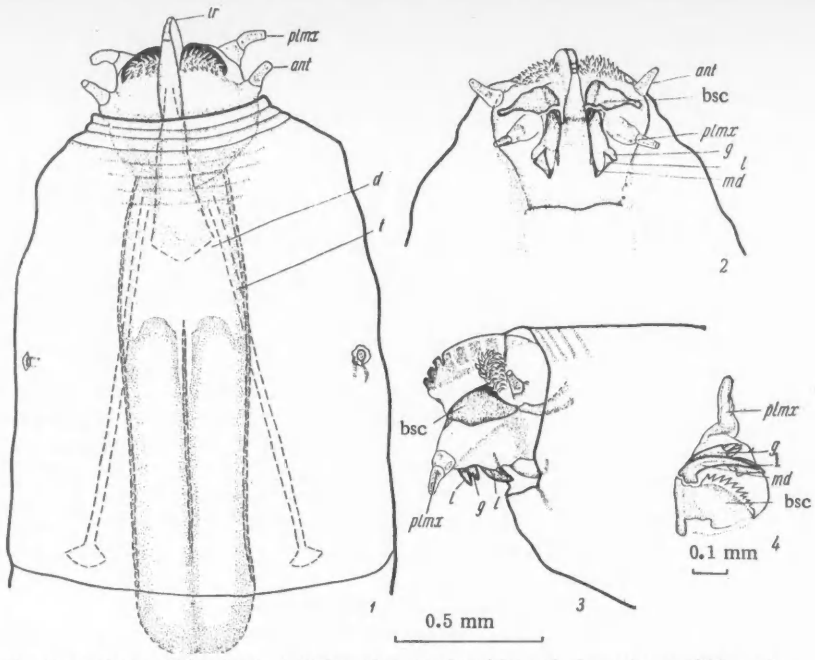

Fig. 2. Head of larval Rhagio. 1, 2, 3) Dorsal, ventral and lateral views; 4) mandible and maxilla.

Key to abbreviations, Figs. 2 and 3.

ant	– antenna	lr	– labrum
bsc	– basal sclerite	mc	– metacephalic process
d	– head capsule	md	– mandible
fsc	– pharyngeal sclerite	mx	– maxilla
g	– galea	plmx	– maxillary palp
l	– lacinia	t	– tentorial process
lb	– labium	v	– vertical plate

The stigmata consist of a stigmatal plate†, around the edge of which are numerous oval apertures i.e., the stigmatal pores (Fig. 6, 1). In the center of the stigmatal plate is situated a stigmatal disk. There is no peritreme. The sinuous ecdysial suture passes across the center of the stigmatal disk. In Symphoromyia larvae, where the stigmatal field is sclerotinized, the stigmatal pores are circular and situated in the center of the stigmatal plate, the margin of which bears numerous, rectangular outgrowths (Fig. 6, 2).

Below is given a brief key for the identification of genera, based on the identification tables of Malloch [1917] and Hennig [1952].

1 (2). Body cylindrical or fusiform, posterior segments not noticeably larger than the others. Paired pseudopods present. Last segment with two strongly elongated outgrowths, which are bordered with long hairs. Tracheal system closed . . . . . Atherix.

2 (1). Ventral pseudopods absent. Last segment of different form.

3 (4). Last segment bearing two slightly curved "horns" which arise from the dorsal margin of the stigmatal field . . . . . Ptiolina.

4 (3). Last segment devoid of horns.

5 (6). Last segment with two broad outgrowths—one dorsal, the other ventral—each slightly serrate . . . . . Symphoromyia.

6 (5). Last segment with 4-6 pointed outgrowths.

7 (8). Last segment with four outgrowths. Lateral processes absent. Basal sclerite toothed . . . . . Rhagio.

8 (7). Between the dorsal and ventral outgrowths there is a single, small tubercle. Basal sclerite without teeth . . . . . Chrysopilus.

Family Dolichopodidae. Dolichopodid larvae (Fig. 1, 2 and 3) are very like larvae of the families Rhagio-

† Zimin [1948] designated this plate as part of the stigmata itself.

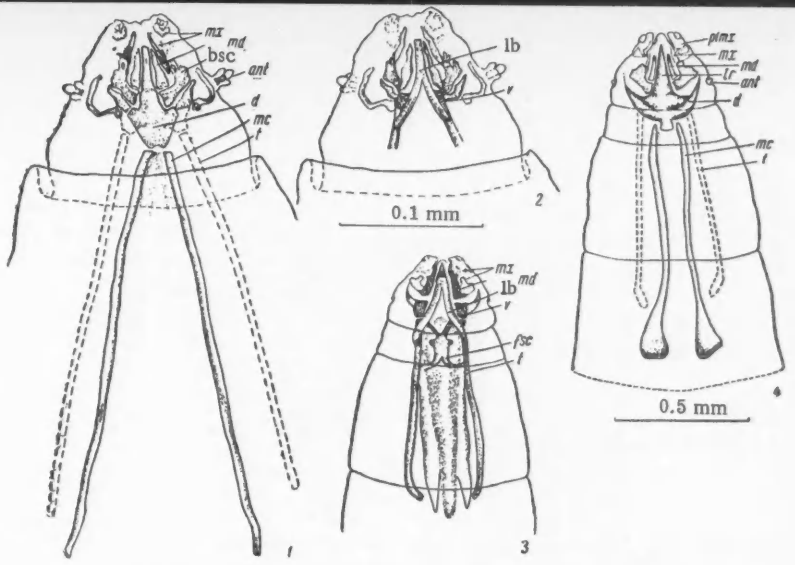

Fig. 3. Head of larval Empididae and Dolichopodidae. 1, 2) head end of larval Empedidae, dorsal and ventral views; 3, 4) head end of larval Medetera, dorsal and ventral views.

nidae and Empididae in general appearance. Their head capsules are markedly reduced and the various elements of the trophic apparatus are strongly sclerotinized. Of two genera, Medetera and Dolichopus, larvae were collected in a damp meadow in June, 1944 (Mikhnevskii District, Moscow Region).

The head capsule of Dolichopodid larvae is reduced to two small lateral plates (Fig. 4) which are clearly visible in dorsal view. The anterior ends of the lateral plates extend as far as the labrum, while the posterior ends are in close proximity to the tentorial processes, which extend far back into the thoracic segments. The lateral plates become wider towards their distal extremities, reminding one of spatulas. Beneath the lateral plates of the head capsule lie the vertical plates, the edges of which form substantial square sclerites between the base of the mandibles and the tentorial processes. The labrum consists of a wedge-shaped sclerotinized plate, which is expanded basally. The mandibles and maxillae are well developed. The mandibular sclerite is crescentic and arises from a massive basal sclerite, which Henning [1952] regarded as a constituent part of the mandible. The maxillae consist of several fused sclerites, one of which is situated at the base of the single-jointed palp. The origins and homologies of these various parts of the trophic apparatus are still somewhat obscure; certain authors have thought it best to speak of a mandibulo-maxillary complex (Hennig [1952]). Just in front of the tentorial processes on the ventral surface of the head, there is a V-shaped sclerite – the labium (according to Bischoff, 1925, this V-shaped sclerite is the hypopharynx).

The whole trophic complex, together with the lateral plates, except for their posterior edges, does not normally extend as far back as the thorax (Fig. 3, 1).

The ventral side of the abdominal segments bears a row of large tubercles and several rows of ridges (Fig. 4, 3 and 7). The row of tubercles is divided by the mid-line into two parts; each tubercle consists of a large cuticularized process, sclerotinized at its tip. The tubercles surround, as it were, rows of smaller outgrowths which are arranged symmetrically.

The structure of the tubercles and ridges in larvae of the genus Systenus (larvae obtained from pasture soil, Kabardinka, Krasnodarsk Region, June 2, 1956) differs from the above only in a few details (c.f., Fig. 4, 3 and 6).

The anal segment is rather variable in its structure. In several forms e.g., in larvae belonging to the two genera Dolichopus and Medetera, this segment is in many respects like the corresponding segment in Rhagio larvae, whereas in others, e.g., Neurogona (Fig. 5, 8 collected in woodland litter, Zvenigorodskii District, Moscow Region, July 7, 1957) it more closely resembles the condition in the Empididae. If both outgrowths are present on this segment, the dorsal outgrowth is always shorter than the ventral (Fig. 5, 7). In Systenus the dorsal outgrowth has undergone total reduction (Fig. 5, 9), while in Neurogona, only a small protuberance under the stigma is retained (Fig. 5, 8).

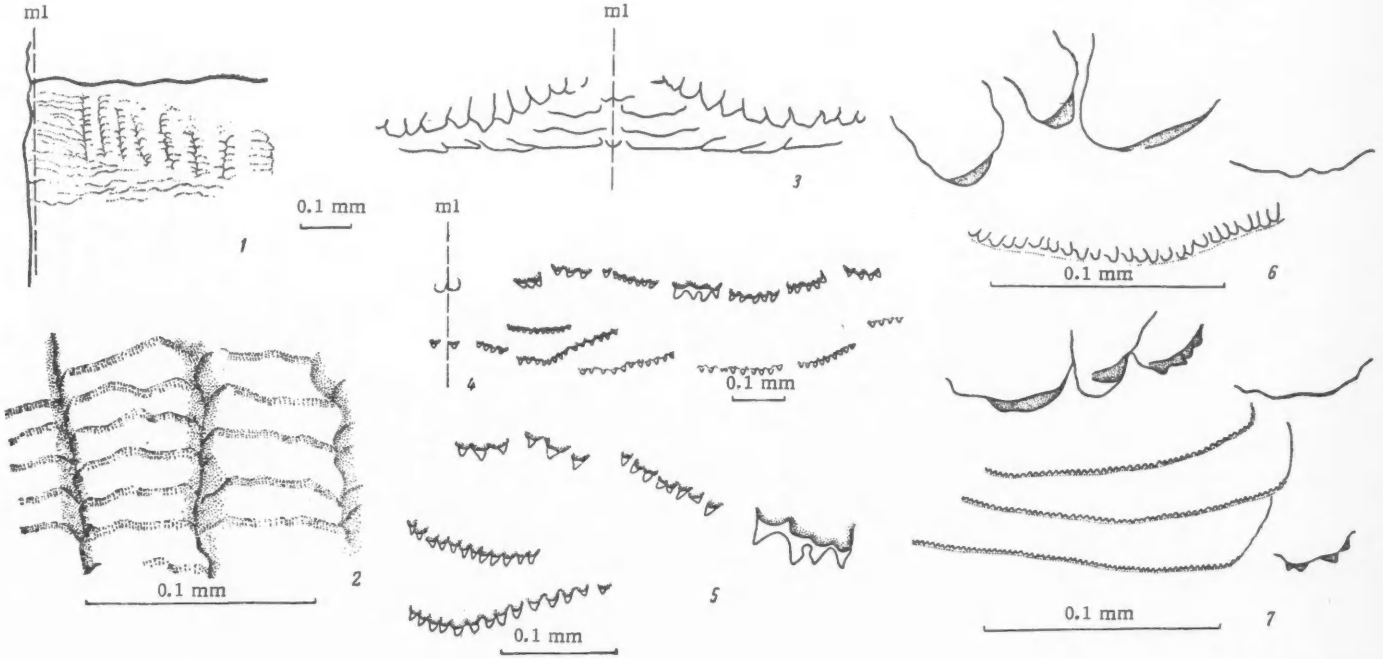

Fig. 4. Front end of abdominal segments (ventral surface). 1, 2) Rhagio larva (Rhagionidae), side view; 4, 5) larva of Empididae, side views; 3, 6) Systenus larva; 7) Medetera larva (Dolichopodidae). ml—mid-line of body.

Under the basal portion of the dorsal outgrowth, where this is present, or directly on the surface of the anal segment where the outgrowth is absent, there are two clearly recognizable stigmata. The stigmatal plate of Medetera larvae (Fig. 6, 3) bears six large apertures, leading into internal atrial chambers (Fig. 6, 4). There is no peritreme. In Neurogona larvae, there are two stigmatal pores which lead into four small internal chambers. The edge of the stigmatal plate is thickened (Fig. 6, 5). Above the stigma, there are four branched setae. A similar stigmatal structure is found in Systenus larvae.

Below is given an identification table for the genera of this family, based on the identification key of Hennig [1952].

1 (2). Last abdominal segment without tooth-like process; rounded, with a single, very small and barely noticeable toothlet under each stigma. . . . . Neurogona.

2 (1). Last segment with four or five cuticularized tooth-like processes.

3 (4). Between the large dorsal and ventral pairs of cuticularized outgrowths there is a pair of small lateral processes; there may be an unpaired cuticularized structure between the dorsal pair of outgrowths. . . . . Aphrosylus.

4 (3). Lateral tooth-like processes absent, or barely distinguishable.

5 (6). Between the large dorsal, cuticularized outgrowths, there is a single, unpaired process . . . . . Argyra, Porphyrops, Dolichopus (in part).

6 (5). Unpaired process absent.

7 (8). Both dorsal outgrowths of the stigmatal field very small. Metacephalic processes with very slight expansions. Stigma with two narrow pores. . . . . Systenus.

8 (7). Both dorsal outgrowths distinct. Metacephalic processes expanded at their ends. Stigma with six to seven circular pores . . . . . Dolichopus, Medetera.

Family Empididae. As was mentioned earlier, the structure of soil-inhabiting larvae of the family Empididae (Fig. 1, 4) is similar to that of larvae belonging to the families Rhagionidae and Dolichopodidae. The mouthparts in the former family are less strongly sclerotinized than in the Dolichopididae and are not, therefore, blackish-brown in color; instead they are a medium or light-brown shade (this description is based on larvae collected in meadows adjoining ashwood, Tkhab Plateau, Krasnodarsk District, June 12, 1955). The structure of the mouth parts was studied in very small individuals, which were embedded in Fora's mountant.

The cephalic plates are relatively large, undivided and feebly sclerotinized posteriorly (Fig. 3, 1 and 2). The lateral processes of the cephalic plates articulate with elbow-like sclerites, from which project the single-jointed antennae. The metacephalic processes are not

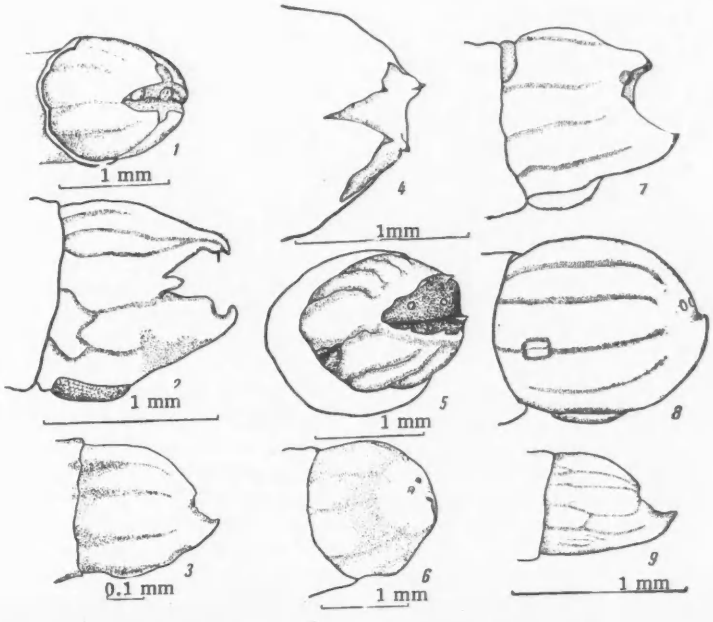

Fig. 5. Anal segment of larvae. 1, 2, 4, 5) Rhagio, Chrysopilus, Symphoromyia (Rhagionidae); 3, 6) Empididae; 7, 8, 9) Medetera, Neurogona, Systenus (Dolichopodidae).

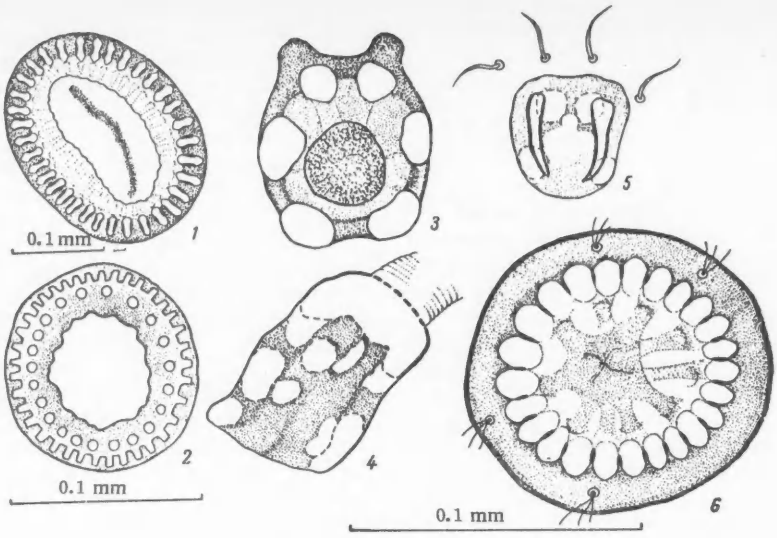

Fig. 6. Posterior stigmata of various larvae. 1, 2) Rhagio, Symphoromyia (Rhagionidae); 3, 4) Medetera; 5) Neurogona (Dolichopodidae); 6) Empididae.

expanded at their end. Except for the above-mentioned features, the larvae closely resemble those of the Dolichopodidae.

The body of the larva is devoid of appendages; on the ventral surface of the anterior portions of the abdominal segments are several rows of ridges, bearing spinules (Fig. 4, 4 and 5). The spinules of the anterior ridges are larger than those on the ridges farther back, but less numerous. The number of these spinules is not constant; often neither the number of spinules to the right and left of the mid-line, nor the size of the ridges correspond. The spinules are directed posteriorly. Analogous tubercles or ridges with their rows of spinules occur in many larvae among the Cyclorrhapha.

The anal segment of Empidid larvae is rounded, with well-developed longitudinal furrows; the posterior stigmata do not project above the surface of the cuticle. Small, cuticularized tubercles occur near to the stigmata in the mid-line (Fig. 5, 3 and 6). The stigmata are round; the periphery of the stigmatal plate is perforated by numerous oval apertures. The peritreme, bearing four branched setae, is well developed (Fig. 6).

A study of our own material has enabled us to construct a key for the identification of soil inhabiting larvae of the families under consideration.

Identification Key for the Three Families of Larvae

1 (2). Dorsal portion of the head capsule very long, extending as far back as the third thoracic segment, strongly convex and elongate – pyriform in outline and forming a complete cover for the endoskeletal processes of the head. The 2-jointed palps of the maxillae are well-developed and clearly visible. The Y-shaped sclerite is absent . . . . . Rhagionidae.

2 (1). Dorsal portion of the head capsule is short, rounded, not extending as far back as the thoracic segments and not covering the endoskeletal processes of the head, which pass into the thorax. Antennae and maxillary palps single-jointed, small. Labial sclerite present.

3 (4). Metacephalic processes expanded at the ends. Head sclerites black or blackish-brown. Anal segment variable in form . . . . . Dolichopodidae.

4 (3). Metacephalic processes not expanded terminally. Head sclerites brown or light brown. Anal segment rounded with longitudinal furrows. A single tubercle occurs at the end of the anal segment near the stigmata. . . . . Empididae.

Certain Structural Peculiarities of Aquatic Larvae.

The families Rhagionidae and Empididae possess among their larvae some typically aquatic forms (Atherix, Atalanta) which differ markedly in their external appearance from the soil-inhabiting larvae of the same families. Those genera which have aquatic larvae share certain common features, even when belonging to different families e.g., absence of stigmata on the body (amphipneustic), strong development of pseudopods on the ventral surface of the abdomen and the presence of a considerable number of seta-bearing outgrowths to the body. The mouthparts of Atherix, in contrast to those of Rhagio, are characterized by a very feeble sclerotinization of their various members; moreover the antennae of Atherix are much longer and slenderer.

The external features of larvae belonging to aquatic genera are so different and distinct as to necessitate the latter being placed in isolated branches of the families Rhagionidae and Empididae. Obviously these structural peculiarities are determined by their way of life. It is noteworthy, for example, that accessory pseudopods are also found in amphibiotic larvae of the Tabanidae.

A comparison of soil-inhabiting and aquatic (amphibiotic) forms indicates that the former have cylindrical bodies, largely devoid of outgrowths bearing setae or spinules, but with ventrally placed ridges and tubercles, capable of assisting movement through the soil; these features are not found in the latter forms. However, the very considerable similarity between such "stable" anatomical features as the mouth parts, testifies to the close affinities of the two groups.

Structure of the Posterior Stigmata in Soil-Inhabiting Larvae. The distribution of stigmata in the larvae under consideration is of the amphipneustic type. Brauns [1953] has discussed in detail the question of distribution of stigmata in soil-inhabiting, dipterous larvae. A trend towards complication of the stigmatal apparatus may be observed in the series Rhagionidae-Dolichopodidae - Empididae. Rhagionid larvae are, to a considerable extent, hygrophilous and many of them occur in rather wet soils such as are found near the banks of ponds, rivers and streams. The strong development of valves which can completely close the stigmatal field on the anal segment may be regarded as a direct adaptation to life in a wet substrate. In all probability, the valves play the same part as do similar structures in soil-inhabiting Tipulid larvae. Symphoromyia larvae, which inhabit drier soils (in the Ferganskii Mountains), than those inhabited by Rhagio larvae, have an open stigmatal field.

In all the Rhagionid larvae we have examined, the stigmata are well developed but their sclerotinization is confined to the stigmatal plate; there is no cavity to the atrium. In the Dolichopodidae and Empididae, there are no lobes capable of bringing about the closure of the stigmatal field. The situation of the stigmata directly on the segmental surface in these forms is accompanied by a reduction in size of the stigmatal plate and spiracular pores. It is important to note that in both the Dolichopodidae and Empididae a well-developed atrial cavity is present with numerous, clearly visible compartments (Fig. 6, 4).

Possible Homologies Between Certain Parts of the Trophic Apparatus. There may be observed among the Brachycera a transition from the well-developed head capsule of certain larvae to its complete suppression, as in the Cyclorrhapha. This problem of the evolutionary pathway by which the head capsule becomes reduced, had occupied the attention of many research workers. "Larval attributes and larval organization are no less important for resolving phylogenetic problems and systematic difficulties than the corresponding anatomical attributes of adult animals" (Gilyarov [1957]). In any comparative study of larval Diptera, the head capsule with its various endoskeletal elements, together with the mouthparts, must receive close attention. Many papers have already been devoted to the subject of the reduction of the head capsule, but our absence of information regarding the larvae of certain families of Diptera does not permit us to make a complete analysis of this trend. Usually only the extreme forms are described, but if such extremes are to be found within the Nematocera and Brachycera, then it is impossible to speak of any close relationships between the Orthorrhapha and the Cyclorrhapha. The members of the Rhagionidae, which many authors (Becker [1910]; Schremmer [1951]) regard as exhibiting a change from feeding on solids to feeding on liquids, are of great importance in suggesting the possible mode of evolution of Cyclorrhaphid mouth parts and pharyngeal skeleton. Within the Rhagionidae the position of the mandibles changes from one in which they work horizontally (as in biting or chewing) to one in which the action is vertical (as in sucking). The shift to extra-intestinal digestion in larval Diptera brings about a reduction in the trophic apparatus, the rudiments of which in the Cyclorrhapha perform to a considerable extent the function of fixation organs for the front end of the motile larva (Gilyarov [1949]; Schremmer [1957]). This change in the position of the mandibles is accompanied by changes in the structure of the head as a whole. It results in the transfer of the mandibular sclerites from the walls of the head capsule to within the capsule. Thus, in the Orthorrhapha the mandibles consist of two members, an external and an internal, whereas in the Cyclorrhapha they are composed of only one. The buccal hooks of the Cyclorrhapha were regarded by Weismann [1863, 1864] as new structures from an evolutionary point of view. This point of view has been upheld by Becker [1940] and also by Snodgrass [1924, 1935, 1953], who described them as secondary cuticular structures. Other authors consider the buccal hooks to be homologous with mandibles (Holmgren [1940]) or maxillae (Meijere [1917]). In recent works Cook [1949] and Ludwig [1949]‡ suggest that they are homologous with the mandibles of other insects. It should be borne in mind that, at the present time, our lack of adequate comparative embryological knowledge is inadequate to settle this point.

Our studies of the three families of larvae indicate that the Empididae are most closely related to the Cyclorrhapha on the basis of external morphology. This affinity between the Empididae and the Cyclorrhapha has been emphasized by many authors. The nature of the body structure and the presence of ridges on the abdominal segments of the larva testifies to this view. On the other hand, the structure of the stigmata and mouth parts is so varied that the question of possible homologies is made difficult as is the elucidation of a possible evolutionary pathway to the Cyclorrhapha.

‡ According to citations by Schremmer [1957].

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CONTRIBUTION TO THE STUDY OF STONE-FLIES (PLECOPTERA) OF THE CAUCASUS. IV. NEW SPECIES OF LEUCTRIDAE

L. A. Zhil'tsova

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Till the present time there were 8 species of Leuctridae recorded in the fauna of the Caucasus, (Martynov [1928: 37-41]; Balinsky [1950: 72-77]; Zhil'tsova [1956: 659-660]). Of these, 6 species were described as new and 2 species as European: Leuctra balcarica Balin., L. collaris Mart., L. dispinata Balin., L. furcatella Mart., L. fusca L., L. hippopus Kemp., L. tarnogradskii Mart., L. uncinata Mart. All these species were again found by us in the Caucasus. Since the material collected was quite plentiful, we were able to make a systematic revision of these species.

The species L. balcarica, described by Balinskii, is related, according to him, to L. tarnogradskii Mart. However, because Martynov's description was inaccurate (illustrations not agreeing with the text), Balinskii could not come to a conclusion regarding the identity of these two species. Most of the characters of L. tarnogradskii are also found in L. balcarica. But these characters are quite general. As a means of distinction between them, Balinskii pointed to the presence of titillators in L. tarnogradskii and their absence in L. balcarica. It is stated in Martynov's text: "Subanal valves and titillators quite long, somewhat curved" (Martynov [1928: 38]). In contradiction to the text the titillators are absent in the drawing given by Martynov (Plate VI, Figs. 1, 2), which shows only a single pair of long outgrowths at the tip of the male abdomen. We have examined the specimens, (6 males and 2 females), which Martynov had used to describe the species. We found that titillators are absent in L. tarnogradskii, just as had been depicted in his drawings, so that there was an obvious error in his text. Thus, the important distinction between L. tarnogradskii and L. balacarica, pointed out by Balinskii, is nonexistent.

Another distinction, pointed out by Balinskii after the text and illustration of Martynov, is the presence of vaginal valves behind the subgenital plate in the female of L. tarnogradskii. Balinskii said that if such is the case, then there is an obvious difference between the females of these two species. Balinskii considered that a definite solution of this problem was impossible without an examination of Martynov's type specimens. A study of the females which served for the description of L. tarnogradskii Mart. has shown that vaginal valves are absent in these, as they generally are in all the species of Leuctra. Consequently this distinction between the two species, proposed by Balinskii, also proved to be invalid. Balinskii did not give any other distinctions, but his drawings definitely prove that he was dealing with the species which had been previously described as L. tarnogradskii. In view of the foregoing account, we consider L. balcarica Balin. as a synonym of L. tarnogradskii Mart.

We collected 9 new species of Leuctra, described below, in different regions of the Caucasus. Together with species formerly described, there are now known 16 species of Leuctridae in the Caucasus. Of this number 13 species belong to the group hippopus Kempny, 2 to the group inermis Kempny, (L. uncinata and L. simplex, sp. n.), and 1 to the group fusca L., (L. fusca L.).

The type specimens of the species described have been deposited in the collection of the Institute of Zoology, AN SSSR, in Leningrad.

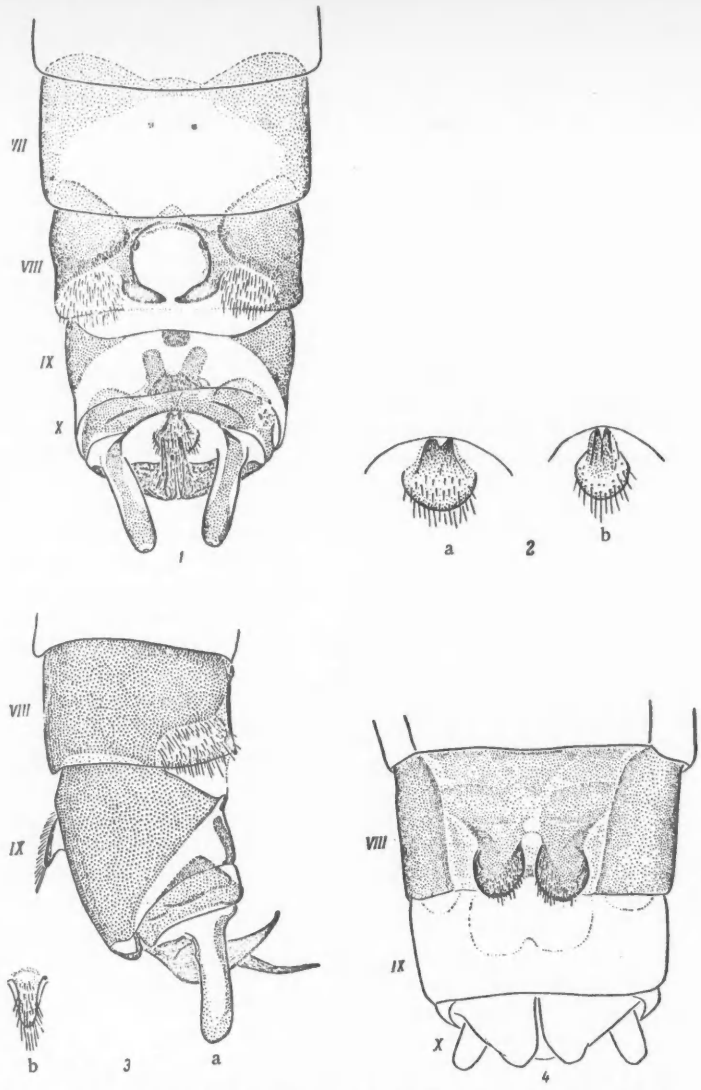
Leuctra dissimilis Zhiltzova, sp. n.

Length of body, male 6.5 – 8.2 mm, female 7.5 – 10 mm. Wing spread, male 11.5 – 15.2 mm, female 14.5 – 15.5 mm. Body color (in alcohol-preserved specimens) dark-brown to blackish, antennae blackish-brown, abdomen in female light-colored, yellowish above. Wings much darkened, brownish, veins dark brown. Pronotum somewhat elongate.

Male (Figs. 1 - 3). Tergite VII light, membranous, except its anterior border and lateral parts. Tergite VIII bears two chitinized outgrowths with beak-like ends, curved inwards. From the base of each outgrowth, medially, there extends a rather broad chitinized band, which forms a bridge between the lateral parts of the tergite. The medial structure, as a whole, forms an almost closed ring. Medial part of the tergite between the outgrowths, as well as its postero-lateral parts are membranous, the latter covered densely with thin setae.

Tergite IX with the chitinization of the anterior border interrupted in the middle; a small transverse spot near this border; another, larger spot, with a deep incision at its anterior boder, at the posterior border of the tergite; the incision may not be so deep in certain specimens. Posterior border to tergite X weakly curved, the tergite being brown with two small light spots in the middle. Supra-anal lobe* moderate in size, brown-

*Brinck [1956:118] proposes to call it "supra-anal plate" or "supra-anal process".



Figs. 1 - 4. Leuctra dissimilis Zhil., sp. n. 1) End of male abdomen, dorsally; 2) male supra-anal lobe: a) holotype, b) paratype; 3:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 4) end of femal abdomen, ventrally. VII - X, numbers of segments.

ish, covered with thin setae; two broad brown brands, proceeding obliquely backwards from the base, fuzzy, merging medially; posterior border semicircular; length of lobe equal or somewhat greater than its width. The shape of the supra-anal lobe somewhat variable, being narrower in some specimens, with the bands better defined (Fig. 2, a, b). Cerci cylindrical, quite long and and thin, with brown bands proceeding along the cerci from the posterior border of tergite X. Ventral plate, or vesicle† (Fig. 3, b), moderate in size, elongate, (length exceeding width more than twice), narrowing toward the apex, removed from the anterior border of the sternite by a space equal to its length, or somewhat greater. Outgrowths of subanal valves a little shorter than titillators‡, broad at the base in side-view, gradually merging into outgrowths; the latter narrowing toward the apex, and somewhat curved upwards (Fig. 3,

†According to Brinck [1956:120] - "vesicle"
‡Brinck [1956:116] substituted for the accepted term "titillators" the term "specillum" in the terminology for external genitalia of Plecoptera, proposed by him.

a). Titillators narrower, a little wider at the base than at the apex, weakly curved.

Female (Fig. 4). Genital plate brown, at the base somewhat lighter medially, terminating in two (medially approaching each other) large, roundish lobes, which are covered with thin setae and which extend slightly onto sternite IX; genital plate transversely convex in front of the lobe bases; area between lobe bases light. Sternite IX whitish in the middle of the anterior border. Subanal valves short, triangular, rounded posteriorly. Cerci brownish, cylindrical, short.

Leuctra dissimilis Zhil., sp. n., according to the structure of the male tergites, and specifically, according to the presence of chitinized outgrowths only on tergite VIII, may be placed in the group hippopus.** But it is difficult to decide to which of the sub-groups, ("a" or "b"), it should be related, as the structure of outgrowths of tergite VIII of the male in this species is very peculiar. According to this character, the shape of the spots on tergite IX, the shape of the ventral plate and a number of other characters in the male genitalia, this species is very distinct from all other species of the hippopus group. The female is distinguished by the shape of the lobes of the genital plate.

Material studied.†† Holotype 1 male, allotype 1 female, paratypes 1 male, 1 female, Western Caucasus, upper reaches of the river Urushten, at the base of Pereval'naia Mountain, 31 V 1957. Source of Laura River, (base of Mt. Pereval'naia), 1 V 1957, 3 females.

Leuctra delamellata Zhiltzova, sp. n.

Length of body, male 5.5 - 6.5 mm, female 6.5 - 8 mm. Wing spread, male 11 - 12 mm, female 14.5 - 16 mm. Coloration of body, antennae and legs (in alcohol-preserved specimens) dark-brown, almost black, abdomen in females whitish above, sometimes with brown spots on I - IV tergites. Wings darkened, brownish; veins brown, not very dark. Width of pronotum somewhat exceeds its length.

Male (Figs. 5, 6). Tergite VII weakly chitinized, medial part light, membranous; anterior border chitinized, thickened; posterior border entirely membranous, light. Two dark chitinized outgrowths proceed directly backwards from the anterior border of the VII tergite; these outgrowths become wide at their ends and are joined by a transverse bridge, forming a U-shaped structure with right angles: The width of this structure somewhat exceeds its length, and its end does not reach to the posterior border of the segment. Anterior border of the IX tergite has its chitinization interrupted in the middle; medial spot is large, right-angled in shape, with a concave anterior border. Tergite X strongly concave posteriorly; supra-anal lobe large, rhomboid in shape, with a distinct, sharply curved posterior border; two dark, laterally curved lines proceed backward from the base of the tergite. Cerci cylindrical, thin, relatively long. Ventral plate absent from the IX sternite. Subanal valves and titillators quite long; the former somewhat shorter, with sharp tips; titillators weakly curved backward at their ends (Fig. 6).

Female (Figs. 7, 8). Genital plate brown, quite broad, uniformly convex; the posterior border forms two elongate lobes, rounded at their ends, with a broad triangular cleft between them, the lobes reaching to beyond the IX sternite. Sub-anal valves triangular, rounded posteriorly. Cerci short, brown.

Leuctra delamellata Zhil., sp. n., undoubtedly belongs to the hippopus group, sub-group "a". The structure of the VIII tergite of the male is identical to that of L. fraterna Mort, and L. alpina Kühtr. The male is close to L. fraterna, being distinguished from it by some details of structure of the chitinized configuration of the VIII tergite, by the shape of the supra-anal lobe and by the absence of the ventral plate on the IX segment. The female is distinguished by the shape of the posterior border of the genital plate.

Material studied. Pre-Caucasus, river Alikonovka near Kislovodsk (900 meters), 24 IV 1955, holotype 1 male, allotype 1 female, paratypes 5 males, 5 females. Armenia. Basin of Lake Sevan; river Akhsu near village Sariyagub (2100 m), 7 V 1956, 31 males, 6 females; same place, 8 IV 1956, 1 male; river Danielidzor above village Karanlug (2050 m), 8 V 1956, 15 males, 2 females. River Arpa above the spa Dzhermuk (2070 m), 20 V 1956, 7 males, 6 females.

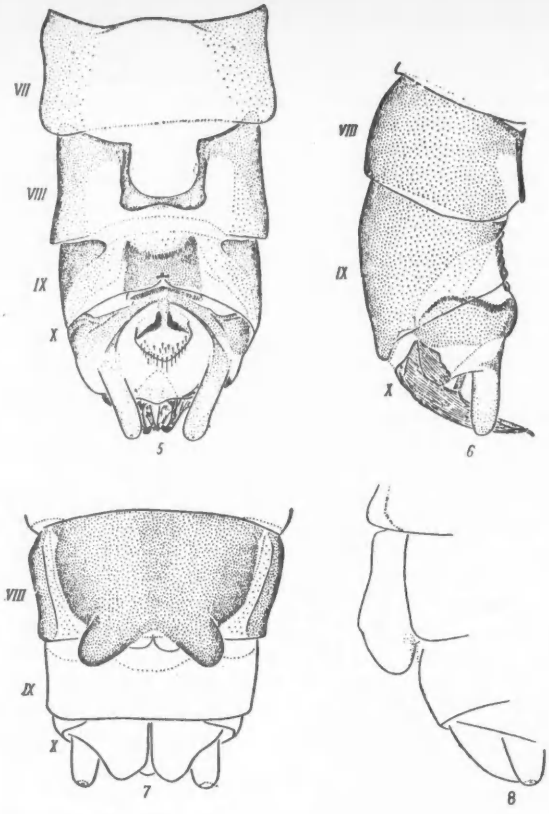
Leuctra sanainica Zhiltzova, sp. n.

Length of body, male 4.5 - 5 mm, female 4.5 - 6 mm. Wing spread, male 11.5 - 12 mm, female 13 - 14 mm. Body color in alcohol-preserved specimens light brown. Wings weakly darkened, veins pale, brownish. Pronotum almost square.

Male (Figs. 9, 10). Tergite VI at the posterior border elevated and light. Tergite VII with an interrupted-in-the-middle chitinization of the anterior border, membranous medially and in the posterior half. Tergite VIII with the chitinization of the anterior border interrupted in the middle; from the anterior border there proceed backward two chitinized outgrowths, which merge into a medial structure in the shape of a U; the internal contour and the posterior border of his structure are well defined; lateral borders indistinct, almost merging with the rest of the surface of the tergite; the structure reaches to the posterior border of the segment. Tergite IX with the chitinization of the anterior border interrupted, medial spot stretched out transversely, with an incised anterior border. Tergite X with a slightly concave, medially light-colored posterior border; supra-anal lobe small, light at the base, membranous, with a rounded posterior border and two brown lines which are near each other at their base. Cerci

** Division of the genus Leuctra into groups according to Aubert [1954:124-126].

†† All the material used to write this paper has been collected by the author, and consequently the collector's name is not mentioned.



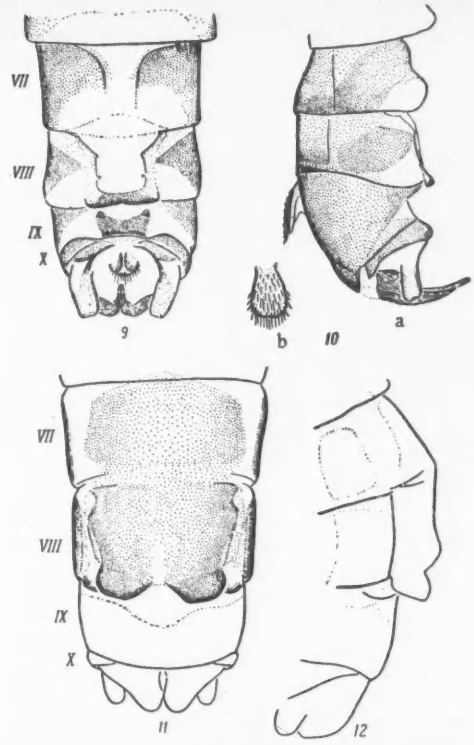
Figs. 5 - 8. Leuctra delamellata Zhil., sp. n. 5) End of male abdomen, dorsally; 6) end of male abdomen, laterally; 7) end of female abdomen, ventrally; 8) female genital plate, laterally. VII - X, numbers of segments.

short, cylindrical; a brown line proceeds from the posterior border of the tergite to the base of the cerci. Ventral plate near the anterior border of the IX sternite (Fig. 10, b), large, broad, somewhat narrowed towards the base, rounded posteriorly. Titillators considerably longer than subanal valves, with dull tips; outgrowths of subanal valves pointed.

Female (Figs. 11, 12). Genital plate brown, lateral parts and lobes of the posterior border darker than the rest of the surface; a shallow, angular incision divides the posterior border into two broad and short lobes with rounded, (or slightly angular), borders, extending a little to the IX sternite. Surface of the genital plate uneven, with two noticeable protrusions—at the border between the VII and VIII sternites, and medially in front of the base of the lobes (Fig. 12). Due to the fact that the surface of the VII sternite is strongly convex toward its posterior border, the border between the VII and VIII sternites seems to be absent. Subanal valves triangular, somewhat elongate, rounded posteriorly. Cerci short, brownish.

Leuctra sanainica Zhil., sp. n., according to the structure of the tergites of the male, viz. the presence of a chitinized structure only on the VII tergite, and its merger into an unpaired figure, belongs to the subgroup "a" of the hippopus group; it is closest, according to this characteristic, to L. alpina Kühtr., at the same time easily distinguished by the following peculiarities: the medial part of the VII tergite is membranous; the chitinized structure of the VIII tergite with indistinct lateral borders, reaching to the posterior border of the segment; the spot on the IX tergite unpaired; ventral plate large and broad. The female has quite a different shape of the lobes of the posterior border.

Material studied. Armenia, brook near village Sanain, (near Alaverdy, 1025 m), 3 V 1956, holotype 1 male, allotype 1 female, paratypes 9 males, 21 females.



Figs. 9 - 12. Leuctra sanainica Zhil., sp. n. 9) End of male abdomen, dorsally; 10:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 11) end of female abdomen, ventrally; 12) end of female abdomen, laterally. VII - X, numbers of segments.

Leuctra zangezurica Zhiltzova, sp. n.

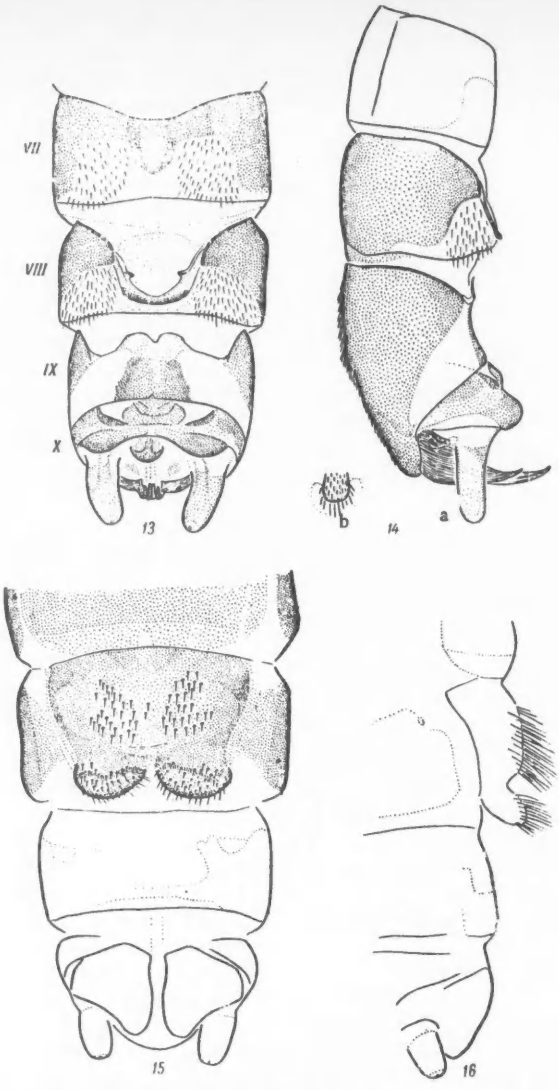
Length of body, male 6 - 7 mm (holotype 7 mm), female 6.5-9 mm (allotype 9 mm). Wing spread, male 12 - 13.5 mm (holotype 12 mm), female 10 - 16.5 mm (allotype 16 mm). The considerable variation in the wing-spread of females is explained by the fact that among the individuals examined there were females with shortened wings. Body color (in alcohol-preserved specimens) brown or dark brown, female abdomen light above, pronotum and head somewhat darker than the other parts. Pronotum almost square, the width hardly exceeding the length. Wings distinctly darkened, brownish, veins brown or dark brown.

Male (Figs. 13, 14). Posterior border of tergite VI membranous. Tergite VII laterally and in the anterior third dark, chitinized; the remainder of the surface up to the posterior border light, membranous. Near the anterior border of tergite VII there is a U-shaped brown figure, without well-defined borders, not sculptured above the surface of the tergite; in some individuals defined less clearly. Tergite VIII with the anterior border not chitinized in the middle; the medial ends of the lateral chitinization become two dark, chitinized outgrowths, posteriorly medially fused with each other into an unpaired formation. Contours of this chitinized figure well defined, posterior border rounded, dark brown. In some individuals this figure is darker in color. Contours of the chitinized figure somewhat variable in different individuals: The band may be more or less narrow and the width of the entire figure may vary, while its length remains constant (in the type specimen the width of the figure is more than 1/3 the width of the tergite, in other specimens it is less than 1/3). The medial spot on the IX tergite large, with a diffuse anterior border, occupying the entire length of the tergite in the holotype; shorter in other specimens, approximately trapezoid in shape. Tergite X with a curved concave posterior border; base of supra-anal lobe indistinct, the lobe relatively small, brownish, with a rounded posterior border, narrower in some specimens than in the type specimen, and with a more defined contour of the base (foot). Cerci much shorter than in other species, cylindrical, brown above. Ventral plate (Fig. 14, b) short, rounded at the end, pressed to the IX sternite, much reduced in some specimens, still shorter than in the type specimen, standing out quite far from the anterior border of the sternite. Titillators much longer than the outgrowths of sub-anal valves, both pairs of appendages sharp-tipped and slightly curved forward.

Female (Figs. 15, 16). Genital plate brown, medially and on the lobes covered with rather long setae. Lobes of the posterior border broad and short, rounded behind, divided by a shallow, narrow cleft; shape of lobes somewhat variable-sometimes the lobes are very blunt behind and more rounded on the sides, as if transversely expanded, or their posterior border may be directed obliquely behind toward the middle, and not parallel to the edge of the sternite. Surface of the genital plate weakly convex, concave near the base of the lobes (Fig. 16). Sub-anal valves short, triangular, rounded at the apex. Cerci, as in other species, short and cylindrical.

Leuctra zangezurica Zhil., sp. n., belongs to the group hippopus Kempny, and to the sub-group of species which have chitinized outgrowths chitinized outgrowths only on the VIII tergite (sub-group "a" according to Aubert [1954]). This species is closest to L. alpina Kühtr. and L. fraterna Mort., being clearly distinguished by the structure of the VII tergite, the shape of the outgrowth of the VIII tergite and of the spot on the IX tergite, the shape of the supra-anal lobe and of the ventral plate. The female has quite a different shape of the lobes of the genital plate. This species has some similarities to the following Caucasian species of the hippopus group, described in this paper: Leuctra sanainica, L. delamellata and L. minuta; it is most similar to L. delamellata.

Material studied. Armenia. The left tributary of the river Arpa above the spa Dzhermuk (2100 m), 20 V 1956, holotype 1 male, allotype 1 female, paratypes 3 females; tributary of the river Vokhchi on the northern slope of



Figs. 13 - 16. Leuctra zangezurica Zhil., sp. n. 13) End of male abdomen, dorsally; 14:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 15) end of female abdomen, ventrally; 16) end of female abdomen, laterally. VII - X, numbers of segments.

the Tashtunski range (2400 m), 3 VII 1956, 7 males, 10 females; river Lichk (tributary of the Megriget) above village Lichk (2200 m), 4 VII 1956, 1 female.

Leuctra minuta Zhiltzova, sp. n.

Length of body, male 4.5 - 5.5 mm (holotype 4.5 mm), female 5 - 7.5 mm (allotype 5 mm); wing-spread, male 8.5 - 12 mm (holotype 8.5 mm), female 10.5 - 14.5 mm (allotype 11.5 mm). Variations in the size of body and wing-spread are considerable; Individuals collected on 16 V 1957 were smaller than at other times; among those collected on 19 V 1957 the females were somewhat larger than the others. The species is distinguished by its very small size. Body color (in alcohol-preserved specimens) light brown, head much darker, female abdomen whitish above. Length of pronotum almost equal to its width; medial disc transversely elongate. Wings weakly darkened, lightly brownish; veins pale, brownish.

Male (Figs. 17, 18). Tergite VII membranous, except at the anterior border and narrow bands at the sides. Tergite VIII with a medially interrupted chitinization of the anterior edge; medial ends of the dark, lateral areas are continued backwards as two chitinized bands which fuse with each other and form a right-angled medial figure. Inner outline of this chitinized figure, which does not reach to the posterior border, is well defined ;lateral borders are diffuse, not well defined; posterior border is sharp, dark. The figure, on the whole, is lighter and smoother than the dark antero-lateral areas of the tergite; a narrow transverse bridge at the point of fusion of the outgrowths, somewhat wider in some specimens than in the holotype. Tergite IX with a single medial transverse spot near the posterior border, occupying approximately 1/2 the length of the tergite; anterior border of the spot slightly concave, in some males incised angularly. Posterior border of the X tergite curved; supra-anal lobe quite large, rounded posteriorly; brown lines, which are near each other at the base of the lobe and then diverge sharply backward, are weakly defined; in the holotype the supra-anal lobe does not have a sharp narrowing at the base (so-called foot); in some specimens this narrowing is sharply defined. Cerci thin, cylindrical, brown. Ventral plate (Fig. 18, b) large, slightly expanded posteriorly, rounded at the end; the length of the plate exceeds its width $1\frac{1}{2}$ times or more; its base is removed from the anterior border of the IX sternite at a distance equal to the length of the plate. Titillators (inner pair of terminal appendages) a little longer than the outgrowths of sub-anal valves; the wide basal part of the valve (Fig. 18, a) is separated from the distal part or from the pointed outgrowth by an incision. Both pairs of terminal appendages relatively short.

Female (Figs. 19, 20). Genital plate brown, lobes and lateral sides somewhat darker, posterior border divided by a shallow incision into two flat, short,and broad lobes, which are weakly rounded posteriorly, and extend to the IX sternite. The shape of the lobes somewhat variable. Surface of the genital plate (Fig. 20) weakly convex ;the lobes are separated from the plate by a shallow trough. Sub-anal valves somewhat elongate, with a concave outer edge and a rounded apex. Cerci thin, brownish.

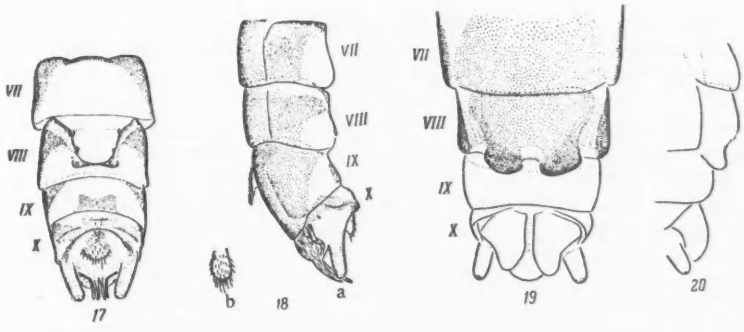
Leuctra minuta, sp. n., according to the structure of tergites VI - IX, belongs to the group hippopus Kempny, and to the subgroup of species which have outgrowths only on the VIII tergite, subgroup "a", resembling L. alpina and L. fraterna. The male is distinguished by the peculiar shape of the medial figure on the VIII tergite, by the presence of a single transverse spot on the IX tergite, the short supra-anal lobe, not as narrowed at the base as in other species. The female is distinguished by the shape of the lobes of the genital plate. Of the Caucasian species there is a certain resemblance to two species of the hippopus group, described in this paper (L. delamellata, L. sanainica), being distinguished from these, as from the European species, by the characters mentioned above.

Material studied. Western Caucasus. Village Krasnaya Polyana (500 - 600 m), a small stream which empties into the river Mzymta, 16 V 1957, holotype 1 male, allotype 1 female, paratypes 2 males, 2 females; stream Monashka (tributary of the Mzymta) in the village Krasnaya Polyana, 19 V 1957, 3 males, 6 females; river Beshenka above Krasnaya Polyana, 20 V 1957, 3 males, 2 females.

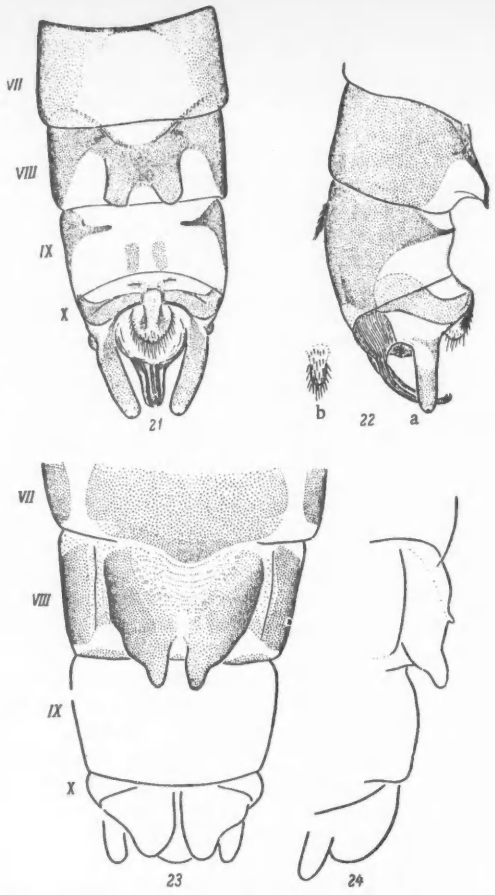
Leuctra torrenticola Zhiltzova, sp. n.

Length of body, male 6 mm, female 7.5 mm. Wing spread, male 11.5 - 12.5 mm (holotype 11.5 mm), female 15 mm. Body color (in alcohol-preserved specimens) relatively light, reddish-brown; antennae dark brown. Wings slightly darkened; veins quite light, reddish or brownish. Length of pronotum considerably greater than its width.

Male (Figs. 21, 22). Tergite VII medially membranous, anterior border strongly chitinized, lateral parts



Figs. 17 - 20. Leuctra minuta Zhil., sp. n. 17) End of male abdomen, dorsally; 18:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 19) end of female abdomen, ventrally; 20) end of female abdomen, laterally. VII - X, numbers of segments.



Figs. 21 - 24. Leuctra torrenticola Zhil., sp. n. 21) End of male abdomen, dorsally; 22:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 23) end of female abdomen, ventrally; 24) end of female abdomen, laterally. VII - X, numbers of segments.

of the tergite are dark. Tergite VIII with a strongly concave anterior border; the medial part of the tergite represents a strongly chitinized, well-defined dark-brown outgrowth, extending to the posterior border of the segment, and having the shape of a broad plate, divided into two parts at its end, slightly bent at an angle, and elevated above the tergite (Fig. 22, a). Tergite IX membranous, with two small longitudinal spots near the posterior border. Tergite X is divided medially by a membranous area, which is the base of the supra-anal lobe. Supra-anal lobe larger, slightly elongate, roundish-oval, weakly angular at the apex; the medial part of the lobe is light colored from the base to the apex, membranous, as if inserted into the X tergite by its base, bordered by two brownish bands, expanded at the ends, which do not reach to the edge of the lobe. In other specimens the supra-anal lobe is wider at the base than in the holotype, and has sharper bands which reach to the edge of the lobe. Cerci quite long, cylindrical, brownish above; a brown line extends from the posterior border of the X tergite to the base of the cerci. Ventral plate (Fig. 22, b) small; in the holotype fused to the sternite in its basal half, rounded at the end, slightly narrowing from the base to the apex. In other specimens the ventral plate has sharper outlines, free in its basal half, its length exceeding its width $1\frac{1}{2}$ times. Titillators slightly shorter than the subanal valves, both pairs of appendages quite long, pointed, with the ends curved forward. The broad basal part of the subanal valve is sharply separated from the narrow and long terminal part (Fig. 22, a).

Female (Figs. 23, 24). Genital plate relatively broad, laterally dark and medially light colored; its posterior border forms two long lobes with parallel inner borders and slightly curved outer ones, wide at their

bases, narrowing to their ends, and extending to the IX sternite. The surface of the subgenital plate is weakly convex, with a small protrusion in the middle of the plate (Fig. 24). subgroup valves of the usual shape, triangular, rounded at the tips. Cerci short, cylindrical.

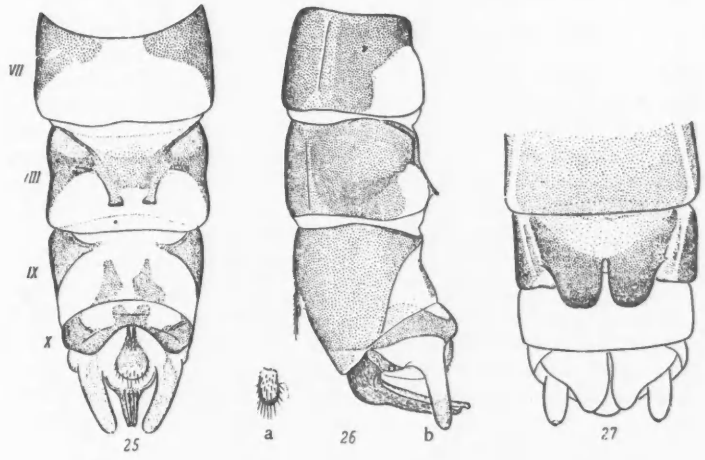
Leuctra torrenticola Zhil., sp. n., according to the presence of an outgrowth only on the VIII tergite, belongs to the group hippopus Kempny, but has an atypical, for this group, shape of the outgrowth of this tergite, which may be regarded as unpaired and relegated to the subgroup "b" but, on the other hand, this outgrowth is similar to that of L. gallica Aubert. According to analogy to the latter species, L. torrenticola, sp. n. could also be placed in the subgroup "a". According to the structure of the last abdominal tergites and their appendages, the male of this species is very distinct from all other species of the hippopus group. The female has peculiar lobes of the subgenital plate. Long, but differently shaped lobes are possessed by the females of L. armata Kemny and L. stupeningi Illies. L. torrenticola bears no resemblance to any of the Caucasian species.

Material studied. Caucasus. Teberdinskii reserve, near Dombai field, stream in the upper reaches of the river Amnauz, 26 X 1954, holotype 1 male, allotype 1 female, paratype 1 male; another stream in the upper reaches of the Amnauz, above the first one, 26 X 1954, 1 male, 1 female (in copula). Elevation more than 1700 meters, (1700 - 2000 m).

Leuctra svanetica Zhiltzova, sp. n.

Length of body, male 6.5 - 7 mm, wing spread of male 11 - 12 mm. Body color light brown, head and thorax somewhat darker, antennae light brown; wings with pale, light-brown veins. Abdominal tergites light colored at posterior ends. Pronotum slightly elongate.

Male (Figs. 25, 26). Tergite VII with the chitinization of the anterior border interrupted in the middle, mostly membranous, antero-lateral areas chitinized. Tergite VIII with two smooth chitinized outgrowths, directed backward, joined together almost along their entire length by a transverse bridge, which is darker than the outgrowths themselves. Only the ends of the outgrowths are free, elevated above the surface of the tergite (Fig. 26). Lateral and posterior borders of these outgrowths are sharply defined, while the medial borders are indistinct; a sharp border between the outgrowths and the connecting bridge is absent, the bridge being distinguished only by its darker color; outgrowths slightly broader at the ends, with a straight posterior edge, do not extend as far as the edge of the segment. Tergite IX with two longitudinal spots of irregular shapes, the outer borders of the spots being concave, the inner ones angular. Posterior border of the X tergite strongly concave, the anterior border forms a bifid protrusion. Supra-anal lobe strongly elongate, with a well-defined narrow foot, rounded at the end, with two longitudinal dark-brown bands, which gradually broaden toward the end and have diffuse outlines. Cerci brown, cylindrical, moderately long; the line proceeding from the posterior border of tergite X to the base of the cerci is less defined than in other species. Ventral plate (Fig. 26, b) small, elongate, with parallel edges and a rounded apex, somewhat separated from the sternite at the base, and removed from its anterior border. Titillators and outgrowths of subanal valves (Fig. 26, a) relatively long, the former



Figs. 25 - 27. Leuctra svanetica Zhil., sp. n. 25) End of male abdomen, dorsally; 26:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 27) end of female abdomen, ventrally. VII - X, numbers of segments.

ones slightly longer; the tips of titillators rounded, straight; outgrowths of sub-anal valves are sharp-tipped, with a forward-curved apex; the basal portions of the valves are strongly chitinized, and produce sharp bends when they form outgrowths.

One male specimen, from the environs of Dombai field (River Alibek, 29 VII 1954), probably belongs to this species, although it differs from the holotype and other specimens collected in Svanetia by a series of small details: 1) On tergite VII, lateral to the medial membranous region of the anterior border, there are two dark bands, thickened, but not separate from the tergite, proceeding backward for 1/3 the length of the tergite; 2) outgrowths of tergite VIII almost not separated from the bridge which connects them, the bridge joining the outgrowths from the bases to the very ends ; the posterior borders of the outgrowths are straight, but oblique in relation to the posterior border of the tergite; 3) the spot on tergite IX unpaired, with an angular incision at its anterior border, the general shape of this spot identical to that of the two spots on tergite IX of the holotype, if they may be imagined to have coalesced along the medial line; 4) supra-anal lobe shorter than in the Svanetian specimens, with the foot less defined; 5) ventral vesicle broader and shorter than in the holotype. All other characteristics, as well as the body size are the same as in the holotype. The structure of titillators and sub-anal valves is especially similar in the two.

A female was caught together with the above-mentioned male in the Alibek river; it probably belongs to the same species as the male, as they were seen to copulate in the test tube. We relate this female to this species with some doubt.

Female (Fig. 27). Genital plate broad, light at the base, deeply divided into two lobes which are rounded at their ends, and extend onto the IX sternite; lobes and lateral parts of the genital plate dark brown, the basal part of the plate weakly convex. Cerci short, brownish. Subanal valves triangular, with slightly concave outer borders, narrowing toward the apex and rounded.

Leuctra svanetica Zhil., sp. n., according to the structure of the tergites of the male, belongs to the hippopus group. If the outgrowth of the VIII tergite is regarded as being paired, then this species, in analogy to L. gallica Aub. (Aubert [1954]), may be placed in the subgroup "a", (i.e. species with two parallel outgrowths), or may be considered as a transitional form between the two subgroups of the hippopus group. The male is distinguished from the other Caucasian species of the hippopus group by the shape of outgrowths of the VIII tergite and by the shape of the spot on tergite IX, the shapes of the supra-anal lobe, the titillators and the sub-anal valves. The female is distinguished by the shape of the lobes of the genital plate.

Material studied. Caucasus. Svanetia, Zagarskii Ridge district (2800 m), stream at the source of the Inguri, 3 VIII 1957, 1 male; stream between the village Koruldashi (2000 m) and the ridge, 5 VIII 1957, 2 males; same place, another stream, 5 VIII 1957, 1 male (holotype). Teberdin reserve, source of the Alibek, 29 VII 1954, 1 female (allotype), 1 male.

Leuctra martynovi Zhiltzova, sp. n.

Length of body, male 4.5 - 6.3 mm (holotype 6.3 mm), female 5.3 - 8.5 mm (allotype 6.5 mm); wing spread, male 10 - 12.5 mm (holotype 12 mm), female 13 - 16 mm (allotype 13.5 mm). Thirty males and 30 females alcohol-preserved specimens were measured. Body color rather dark, brown; head and pronotum sometimes darker, antennae somewhat lighter than the head. Wings weakly darkened, brownish, veins light brown. Pronotum either square or slightly elongate.

Male (Figs. 28, 29). Anterior borders of all abdominal tergites dark, chitinized, posterior borders light, membranous; in some males the VIII and IX segments darker than the others. Tergite VII brown, with a chitinized anterior border, lighter in its medial part, where are located two indistinct longitudinal lines; tergite VII light, membranous along its posterior border. Anterior border of tergite VIII strongly concave; the unpaired chitinized outgrowth of the medial part is lighter and more shiny than the lateral parts, it is narrowed posteriorly and divided into two sharp and short protrusions, which are slightly elevated above the surface of the tergite. The brownish spot on the IX tergite with strongly concave lateral borders and a fuzzy anterior border. Posterior border of the X tergite weakly concave, the anterior border forms a rounded protrusion. Supra-anal lobe relatively short and broad, (in the holotype the breadth is slightly greater than the length), rounded posteriorly, with two dark and broad bands along the sides, the bands being near each other at the base; external borders of the bands are straight, internal borders are curved. Cerci cylindrical, rather short, brownish on top ; from the posterior border of the tergite to the base of the cerci there extends a brown line. Ventral plate of the IX sternite (Fig. 29, b) with distinct outlines, quite large, elongate (length exceeding width almost twice), broadening toward the end and rounded. Titillators noticeably longer than subanal valves, with wider tips than the latter; subanal valves darker than the titillators, narrowed at their tips, pointed, slightly curved forward.

Female (Figs. 30, 31). Genital plate wide, of a uniform color, light-brown, medially convex, covered with rather long setae; posterior border forms two lobes, divided by a shallow cleft, convex medially, rounded posteriorly, extending a little to the IX sternite. Subanal valves triangular, somewhat elongate, rounded posteriorly. Cerci short, light brown. The spermathecal sclerite (two thin rods connected by a curved bridge) can be seen through the VII sternite.

Leuctra martynovi Zhil., sp. n., belongs to the group hippopus Kempny, and to the subgroup "b" (species with an unpaired outgrowth of the VIII tergite). The male, according to the structure of the outgrowth of the VIII ter-

gite, somewhat resembles L. helvetica Aub., but is distinguished from that species by the structure of other segments. According to this characteristic, the male of this species has a remote resemblance to the following Caucasian species: L. dispinata Balin., L. tarnogradskii Mart. and L. furcatella. It is probably closest to the last-named species, but details of structure of the VIII tergite in the two species are different: in L. furcatella the outgrowth extends to the posterior border of the VIII segment, is not narrowed distally, and its ends are not so pointed.

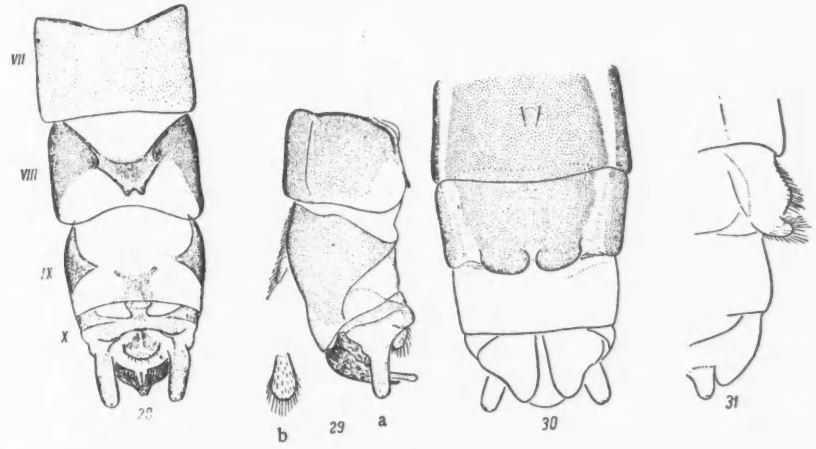
The female is distinguished from all the species in the "b" subgroup by the shape of lobes of the genital plate. In some individuals the genital plate is identical to that of L. minuta, sp. n., in which the lobes of the genital plate are quite flat, darker in comparison to the plate proper, and their outline is somewhat different than in Leuctra martynovi.

Material studied. B. Caucasus. Vicinity of village Krasnaya Polyana (500 m); river Mzymta, 15 V 1957, 18 males, 20 females; 23 V 1957, 5 males, 4 females; stream Laura, 18 V 1957, 1 female; river Beshenka, 28 V 1957, 1 female. Military-Osetin highway near village Zaramag: stream in Vartsei gorge, 21 V 1955, 7 males, 26 females; river Adaikomdon, 22 V 1955, 1 female. River Rioni near village Oni, 14 VI 1957, 1 male, 1 female. Military-Georgian highway, tributaries of the river Terek; river Lars, 30 IV 1955, 10 males, 2 females; river Gudashaurskaya Aragva near village Kazbegi (1770 m), 4 VI 1955, holotype 1 male, allotype 1 female, paratypes 24 males, 26 females; river Kistinka, 8 VI 1955, 6 males, 1 female. M. Caucasus. Bakurianai, 9 V 1954, 1 male (Zh. Tosunova). Armenia. River Arpa below the spa Dzhermuk, 21 V 1956, 2 males; tributary of river Vokhchi on the northern slope of the Tashtun ridge, 3 VII 1956, 6 males, tributary of river Megriget in the vicinity of village Lichk, 4 VII 1956, 1 male. Elevations of the localities from 500 m (river Mzymta) to 2200 m (slopes of the Tashtun ridge).

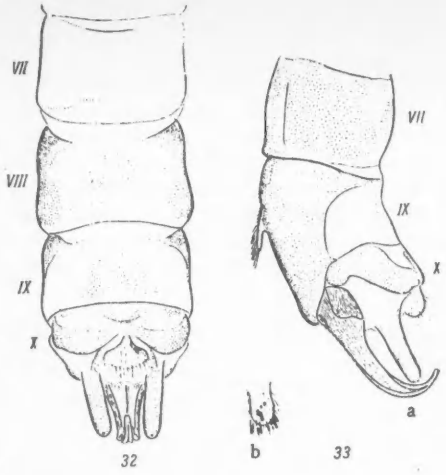
Leuctra simplex Zhiltzova, sp. n.

Male (Figs. 32, 33). Length of body 4.5 - 5.5 mm, wing-spread 10 - 11.5 mm. Body color light, brownish, head somewhat darker, antennae whitish at base, light-brown the rest of the way. Wings weakly darkened, veins brownish. The second male specimen is lighter in color. The width of the pronotum either slightly greater than its length or equal to it.

Abdominal tergites, as in species of the inermis group, without outgrowths. The membranous tergites VIII and IX have one ill-defined brown spot each, the spot on tergite VIII triangular, with rounded corners, that on tergite IX trapeze-shaped with indistinct anterior and posterior borders (these spots are absent in the second, weakly pigmented specimen). Tergites VII and VIII, and partially tergite X, medially with long, fine setae. Tergite X angularly incised posteriorly; the base of the supra-anal lobe is located in this incision. Anterior border of tergite X forms a large bifid protrusion. Supra-anal lobe transversely expanded broad, covered with fine setae, with a well-defined short foot; from the base of the lobe, along the lateral borders there proceed two narrow brownish lines. Cerci fine, cylindrical, relatively long, brownish above, light on the sides, at the base. Ventral plate of the IX segment large, separate, elongate, (twice as long as it is wide), rounded at the tip. Titillators slightly longer than the subanal valves; both pairs of appendages long, strongly curved upward; titillators light, gradually tapering, rounded at tips; outgrowths of subanal valves strongly pointed, very thin at the tips, with the inner edge serrate at the base.



Figs. 28 - 31. Leuctra martynovi Zhil., sp. n. 28) End of male abdomen, dorsally; 29:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite; 30) end of female abdomen, ventrally; 31) end of female abdomen, laterally. VII - X, numbers of segments.



Figs. 32 - 33. Leuctra simplex Zhil., sp. n. 32) End of male abdomen, dorsally; 33:a) end of male abdomen, laterally, b) ventral plate of the IX male sternite. VII - X, numbers of segments.

L. simplex Zhil., sp. n., is distinguished from other species of the inermis group by the following characteristics: 1) A large spot is present on tergite VIII (in addition to this species such a spot is present only in L. metsovonica Aub.); 2) the spot on tergite IX is large and trapeze shaped; 3) supra-anal lobe very broad and short, with a well-defined foot; 4) titillators and outgrowths of subanal valves long, curved; 5) sternite IX very elongate.

This species is well distinguished from the other Caucasian species of the inermis group. L. uncinata Mart., by the structure of tergites VIII - X, the shape of the supra-anal lobe, the presence of a ventral plate, the shape of the cerci from the side, the considerable length of the titillators and subanal valves, which are curved upward.

Female not known.

Material studied. Western Caucasus. River Mzymta near village Krasnaya Polyana (500 m), 23 V 1957, holotype, 1 male; river Sochi near village Navaginka, 12 V 1957, 1 male.

SUMMARY

Until now only eight species of Leuctridae had been described as being present in the fauna of the Caucasus (Martynov [1928]; Balinsky [1950]; Zhil'tsova [1956]): Leuctra balcaria Balin., L. collaris Mort. L. dispinata Balin., L. furcatella Mart., L. fusca L., L. hippopus Kemp. L. tarnogradskii Mart., L. uncinata Mart.

The specimens that we examined were of Leuctra tarnogradskii Mart. By comparing the description of L. balcarica with the description and specimens of L. tarnogradskii, we have shown that there exists actually no difference between these two types. Thus, L. balcarica must be considered as being synonymous with L. tarnogradskii.

This work has led to the uncovering of nine new species of Leuctridae; consequently we now know of sixteen species of Leuctridae appearing in the Caucasus, of which thirteen belong to the group hippopus, two to the group inermis, and one to the group fusca.

L. dissimilis Zhil., sp. n. (Figs. 1-4). We have placed this into the group hippopus. It is distinguished from the other species, in the case of the male, by the shape of the eighth tergite outgrowth, the markings on the ninth and by the form of the ventral plate. The lobes of the genital plate in the female has a different shape as well.

Western Caucasus: the sources of the Uruchten and Laura rivers.

L. delamellata Zhil., sp. n. (Figs. 5-8). This belongs to the group hippopus, sub-group "a". The male resembles those of L. fraterna, differing only in the shape of the eighth tergite, the shape of the supra-anal lobe, and the absence of a ventral plate. The female differs in the shape of the posterior border on the genital plate.

Pre-Caucasus: Kislovodsk. Armenia: basin of Lake Sevan; the Arpa river.

L. sanainica Zhil., sp. n. (Figs. 9-12). The difference here lies in the shape of the tergites of the males, which actually belong to the group hippopus, subgroup "a". The eighth tergite resembles that of the male L. alpina, although there is a distinct difference in details. Other than this, there is also a large difference in the shape of tergites seven and nine and in the form of the ventral plate.

The female L. sanainica differs from all other females in the group hippopus by the form of the genital plate.

Armenia; Sanain.

L. zangezurica Zhil., sp. n. (Figs. 13-16). This belongs to the group hippopus, subgroup "a". It resembles two European species (L. alpina, L. fraterna) and three Caucasian species (L. sanainica, L. delamellata, L. minuta), especially L. delamellata, from which it differs in the shape of the seventh, eighth and ninth tergites and in the ventral plate. The female is distinguished by the form of its genital plate.

Armenia: tributaries of the Arpa, Vokhchi, and Lichk rivers. Altitudes: 2100-1400 m.

L. minuta Zhil., sp. n. (Figs. 17-20). Due to the shape of the sixth through ninth tergites, this is tentatively placed in the group hippopus, subgroup "a". It also slightly resembles L. alpina and L. fraterna. The male is distinguished by the shape of a medial figure on tergite eight and the presence of a transverse mark on tergite nine; also a short supra-anal lobe. The female differs by the shape of the lobes on the genital plate. L. minuta resembles two Caucasian species as well: L. delamellata and L. sanainica. In these species, as in the European species, it is distinguished by the characteristics mentioned above.

Western Caucasus: Krasnaya Polyana, 500-600 m.

L. torrenticola Zhil., sp. n. (Figs. 21-14). This is of the group hippopus, but the subgroup is, as of now, not

yet certain. The male is easily distinguished from all other species in this group, both European and Caucasian. The female of these species has, as an outstanding charac characteristic, elongated lobes, which are also indicative of the species L. armata and L. stupeningi. However, there is also a difference in the shape of the lobes.

Caucasus: Teberda. 1700-2000 m.

L. svanetica Zhil., sp. n. (Figs. 25-27). This belongs to the group hippopus. By analogy with L. gallica, it is either tentatively placed in subgroup "a" or considered to be a transitional form between the two subgroups. The male is distinguished from the other Caucasian species in this group by the structure of the outgrowths on tergite eight, form of the mark on tergite nine and by the shape of the supra-anal lobe, titillators, and the subanal lobe..

Caucasus: Svanetica; sources of the Inguri and Koldachi rivers, 2000-2800 m; Teberda, source of the Alibek river.

L. martynovi Zhil., sp. n. (Figs. 28-31). This belongs to the group hippopus, subgroup "b". The shape of the outgrowths on tergite eight of the male resembles, to a certain degree, those of L. helvetica. The shape of the other tergites in these species also differ. Among the Caucasian species, L. martynovi resembles, due to the shape of tergite eight, the male of L. furcatella and also somewhat L. dispinata and L. tarnogradskii, as well as differing in certain other details of the tergites. The female is distinguished in all the species of subgroup "b" by the shape of the lobes of the genital plate. Certain specimens also resemble L. minuta.

Northern Caucasus: Krasnaya Polyana (500-600 m), the surroundings of Zaramag; the Rioni, Lars, Gudashaurskaya, Aragva, and Kistinka rivers. Caucasus Minor: Bakuriani Armenia: the Arpa, Vokhchi, and Megriget rivers. Altitudes: 500-2200 m.

L. simplex Zhil., sp. n. (Figs. 32-33). This belongs to the group inermis, differing from the other species in the following characteristics: tergite eight has a spot, tergite nine has a large trapezoidal mark, the supra-anal lobe is very broad and short, the titillators and supra-anal valves are long and curved, and sternite nine is very elongated. This species is easily distinguished from L. unicinata by the shape of tergites eight, nine, and ten, by the form of the supra-anal lobe, by the presence of a ventral plate, by the shape of the cerci as seen from the side, and by the considerable length of the titillators and subanal valves.

Western Caucasus: the Mzymta and Sochi rivers.

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SOME NEW AND LITTLE KNOWN MEALYBUGS (HOMOPTERA, COCCOIDEA, PSEUDOCOCCIDAE) OF THE LENINGRAD REGION

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This paper constitutes the description of a new genus, Boreococcus Danzig, gen. n., and of two new species of mealybugs (Coccoidea, Pseudococcidae), Boreococcus ingricus Danzig, sp. n., and Paroudablis vaccinii Danzig, sp. n., established by the author while studying the Coccoidea of the Leningrad region. In addition to this, the description of two little-known mealybugs, Spinococcus calluneti (Lndgr.) and Peliococcopsis parvicerarius (Goux), is also given; the last-named one is recorded by the author for the first time [1959] in the fauna of the USSR.

All the description are given according to adult females; body dimensions were taken from preserved specimens.

Type specimens of new species are kept in the collections of the Institute of Zoology, AN SSSR in Leningrad.

The author wishes to take this opportunity to thank Prof. N. S. Borkhsenius for his valuable suggestions.

GENUS BOREOCOCCUS DANZIG, gen. n.

Type species - Boreococcus ingricus Danzig, sp. n.

Body elongate-oval, covered with white powdery wax. External integument elastic, body segmentation distinct. Eyes present, round pores not present near eyes. Antennae 9-membered. Legs short; tibiae longer than tarsi, claws with a small tooth. Anterior and posterior dorsal stomata well developed. Spiracles cup-shaped. Anal ring almost circular, with a double external row of small roundish pores, one internal row of large irregular pores and 6 setae. Anal segments ill-defined, with an apical and subapical setae and several hairs.

Discoid pores of one type, multilocular. Among these there are the usual multilocular pores and stellate ones. Cylindrical pores of one type, tubular, of the usual structure. Cerarii few in number, consist of conical spines and stellate multilocular pores. Spines, other than those which constitute cerarii, absent. Spinelets of different lengths, found on the dorsal surface and along the edge of the ventral surface. Hairs numerous on the ventral body surface.

Systematically, the new genus is closely related to the genus Annulococcus James [1936] from Eastern Africa, whose only species, A. ugandaensis James, was recently redescribed in detail by Lotto [1957]. However, a different structure of the tubular pores and the character of disposition of the stellate multilocular pores make it necessary to separate this into a separate genus.

Boreococcus ingricus Danzig, sp. n. (Fig. 1)

Body elongate-oval, light-pink in color, 2.5 mm long and 1 mm wide. Antennae 9-membered; all the members are broad. Length of members (in microns): I 43.2, II 30.2, III 23.7, IV 21.6, V 25.9, VI 21.6, VII 25.9, VIII 25.9, IX 30.2. The loop of the rostellar setae short, only 1.5 times as long as the rostellum. Legs short, with thin segments; coxae of posterior legs without transparent pores, femora about 116.6 microns in length, tibiae 142.5 microns, tarsi 56.2 microns, claw with a small tooth. Anal ring almost circular, with a double external and a single internal row of pores and with 6 setae 108.2 microns in length. Anal segments weakly defined, with an apical seta 108.2 microns long, a subapical seta 30.2 microns long and with 2 hairs. Abdominal stoma single, small, round, 43.2 microns in diameter.

Multilocular pores of the usual structure, numerous on both body surfaces. They are distributed irregularly throughout the body and form bands along the posterior border of the 5-7 sternites of the abdomen. Size of pores varies from 3.8 to 6.5 microns, depending on the number of locules (8-17 locules). Large pores (15-17 locules) are mainly concentrated along the edge of the body and on the posterior abdominal segments. Stellate multilocular pores are found in the cerarii, singly along the body edge, and singly or in pairs near the spiracles. They are of the same size as the smallest multilocular pores of the usual type. Tubular pores, 9.4 microns long and 3.1 microns in diameter, are found along the body edge together with large multilocular pores, and they are less numerous anteriad; on the dorsal surface they are found singly on the cephalothorax and on the 1st abdominal tergite, and form transverse bands on abdominal tergites 2 to 7; on the ventral surface pores of this size are found singly on the 3-4 abdominal sternites and form transverse bands on abdominal sternites 5 to 7.

Four pairs of cerarii, consisting of conical spines and stellate multilocular pores, the pores being often not concentrated near the spines, but rather placed at some distance from them. Formula of cerarii (length of spines in microns shown within the brackets): C_{18} = 4 spines

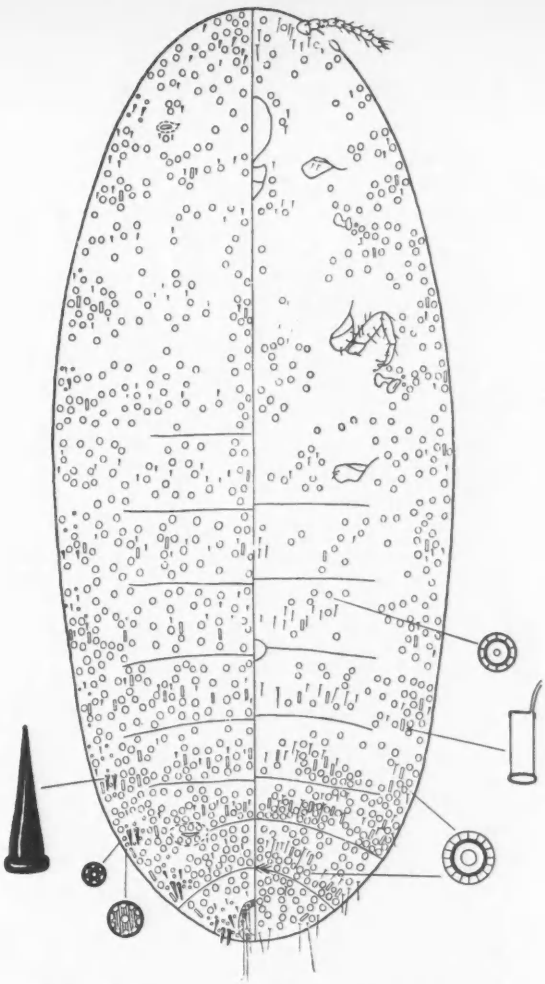

Fig. 1. Boreococcus ingricus Danzig, sp. n., ♀.

(17.3 -22.6) + 10-14 pores; C_{15-17} = 2 spines (17.3 -22.6) + 3 – 6 pores. Other cerarii indistinct.

Spinelets thin, long, up to 12 microns in length, disposed throughout all the tergites and along the edge of the ventral surface. Hairs numerous on the ventral body surface.

Biology and distribution. Ovipositing females were collected on Sept. 20, 1956 at the bases of leaves of Carex sp. in a dry pine forest on the southern sandy slope of the Pukhtola mountain, near Zelenogorsk. About 50 plants were infested with the mealybugs. The degree of infestation was considerable, with several insects on each plant.

It is to be noted that the southern slope of Mt. Pukhtola is invaded by a number of southern species. Anamaspis loewi (Colvée) is found here, and this is the only locality for this species in the Leningrad region. Pseudococcus perrisii (Sign.) also lives here, as well as in the southern part of the region, in the Luzhsk district. The main distribution of these two species is more southerly.

The eggs winter in loose, white egg sacs. The eggs are yellow in color.

Paroudablis vaccinii Danzig., sp. n., (The Cranberry Mealybug)(Fig. 2).

Body broadly oval, up to 3 mm in length and 1.5 mm in width. Antennae 9- membered, all the members thin. Average length of antennal segments (in microns): I 43.2, II 68.1, III 68.1, IV 51.8, V 56.2, VI 43.2, VII 43.2, VIII 43.2, IX 68.1. The loop of the rostellar setae not longer than the rostellum. Legs well developed. Femur, tibia and tarsus with long, thick setae. Coxae of posterior legs without transparent pores, femora about 194.4 microns in length, tibiae 194.4

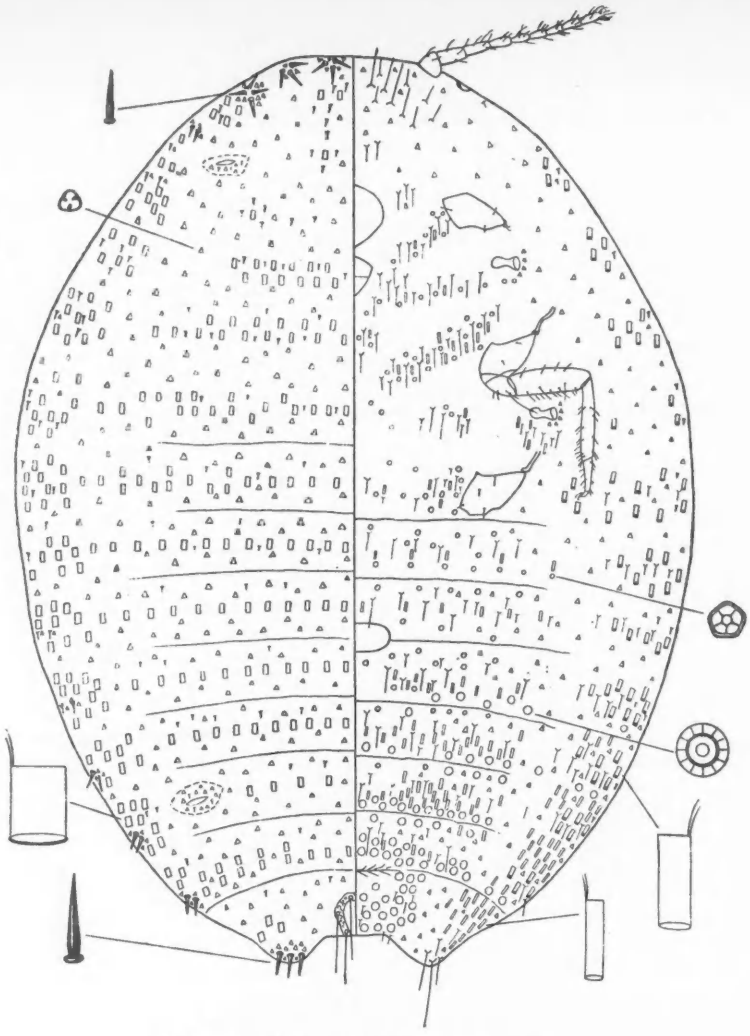

Fig. 2. Paroudalis vaccinii Danzig, sp. n., ♀.

microns, tarse 86.4 microns, claw with a tooth. Abdominal stoma large, oval. Anal ring with 2 external and 1 internal row of small roundish pores and with 6 setae, about 151.2 microns long. Anal segments protrude noticeably on the sides of the anal ring, with an apical seta about 86.4 microns and with one seta-like hair.

Multilocular pores are found only on the ventral surface of the abdomen. They form a transverse row on 4-5 sternites, 2 rows on the 6th sternite, a band and a row on the 7th, and a band on the 8th sternite. Five-locular pores are disposed on the ventral surface of the thorax and on the 2nd to 7th abdominal sternites. Three-locular pores are numerous on the dorsal surface and along the border of the ventral surface. Tubular pores are of three sizes. Wide ones, 7.8 microns in diameter and 10.9 microns in length are disposed on the dorsal body surface; they are placed in groups along the edge of the body, singly on the head and form 3 narrow bands on the thorax and a transverse row on the 1st to 7th abdominal tergites. Narrow pores and medium-sized ones are found on the ventral surface. Medium-sized pores, 4.7 microns in diameter and 12.5 microns long are placed in groups along the edge of the body. Narrow pores, 2.5 microns in diameter and 10.9 microns in length are numerous on the ventral surface of the thorax, and form a transverse row on the 2nd and 3rd abdominal sternites, a double row on the 4th sternite, a band on the 5th and 6th sternites, 2 rows on the 7th sternite and a band along the edge of 5th to 8th abdominal sternites.

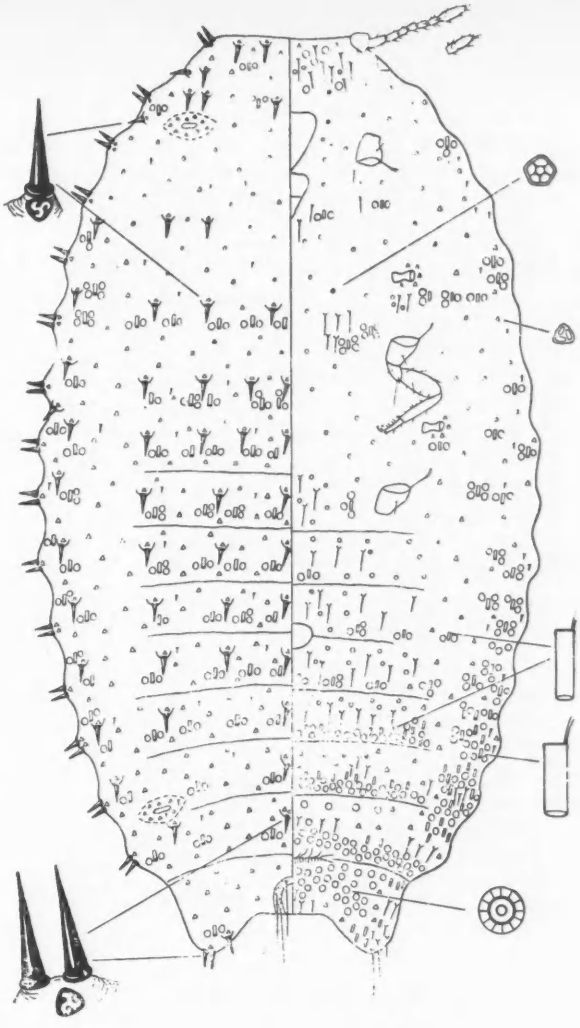

Fig. 3. Spinococcus calluneti (Lndgr.), ♀.

A number of cerarii, consisting of thin conical spines and of three locular pores, extend along the edge of the body. Eight to eleven pairs are clearly defined: C_{1-4} and C_{15-18}, sometimes C_{1-5} and C_{13-18}. Formula of the cerarii: C_{1-2} = 2-3 spines (9.3 microns) + 3-6 pores; C_3 = 4 spines (7.8 microns) + 8-9 pores; C_{4-5} = 2-3 spines (6.2 microns) + 3-5 pores; C_{15-16} = 2 spines (9.3 microns) + 2-4 pores; C_{17} = 2 spines (7.8 microns) + 4-8 pores; C_{18} = 3 spines (12.5 microns) + 10-15 pores.

Spinelets thin, up to 9.3 microns, are found on all the tergites and along the edge of the ventral body surface. Long hairs numerous on the sternites.

Biology and distribution. Ovipositing females were collected on July 31, 1956 on the lower surface of leaves of cranberry (Vaccinium vitis idaea L.) in a mixed shrub forest on the shores of Lake Vuoksa near the village Gory in the Priozerskii district; in all, 15 females were found.

Egg sac is white, oval 4.5 mm long and 2.5 mm wide. Male cocoon is white, elongate, 1.5 mm long and 0.5 mm wide.

Systematic remarks. The new species is related to Paroudablis borchsenii Mat. (Matesova, 1957), but is distinguished from it by the presence of medium sized pores in addition to large and small tubular pores, by the absence of multilocular pores on the thoracic sternites, by the large number of cerarii and by other characteristics.

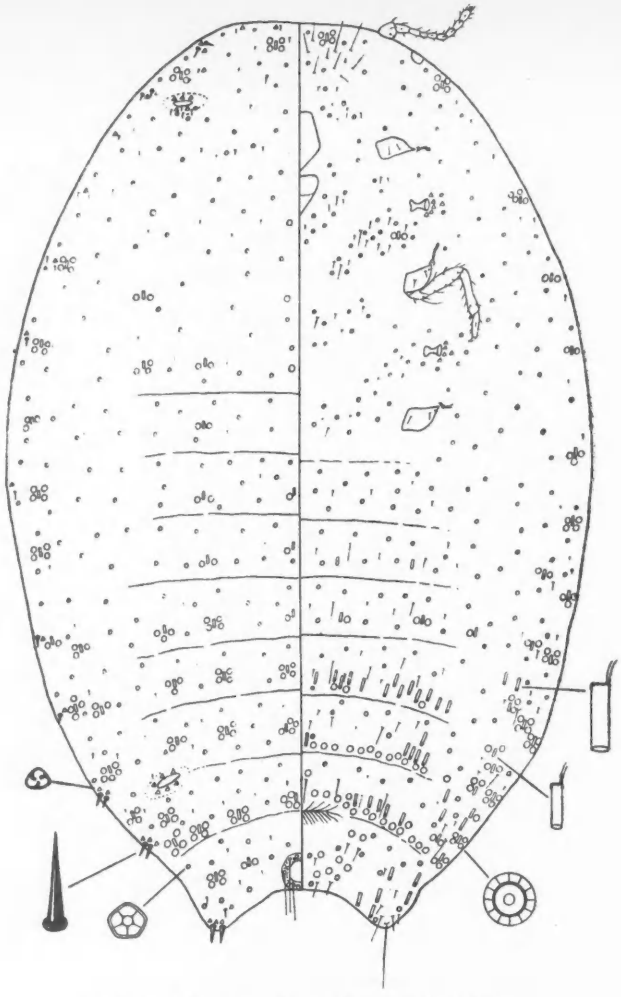

Fig. 4. Peliococcopsis parvicerarius (Goux), ♀.

Spinococcus calluneti (Lndgr.) (Fig. 3)

Body elongate-oval, pink, covered with powdery wax, with loose wax plates at the tip of the body, about 2.5 mm in length and 1 mm in width. Antennae 8-membered. In some specimens there is a transverse ridge on the 8th segment of one or both antennae. Length of antennal segments in microns : I 43.2, II 51.8, III 38.9, IV 21.6, V 25.9, VI 25.9, VII 30.2, VIII 86.4 . The loop of rostellar setae twice as long as the rostellum. Legs developed normally ; coxae of posterior legs withour transparent pores, femora 138.2 microns long, tibiae 133.9 microns, tarsi 63.8 microns, claw is toothed. Anal ring oval, with a double external and a single internal row of small roundish pores and with 6 setae 95.0 microns in length. Anal segments conical, large, with an apical seta 138.2 microns long; ventral surface of the segments with 1 subapical seta 63.8 microns long and with a seta-like hair. One or two abdominal stomata, varying greatly in size.

Groups of 2 -3 (more seldom of 1 and 4) multilocular pores are formed around 1 tubular gland, and these are formed into a double row along the edge of the body on the dorsal surface; there are individual groups on the head, and they form three transverse rows on the cephalothorax and also a transverse row on the 1st - 7th abdominal tergites; on the ventral surface they form a row along the edge of the body; the row becomes a band on the metathorax and the abdomen; they are also placed near the spiracles and the coxae, and form transverse rows on the 2nd - 4th abdominal sternites. Multilocular pores, not collected into groups, are found on the frons along the edge of the 5th - 8th abdominal sternites, form a double

row on the 5th sternite, bands on the 6th and the 8th, a band and a row on the 7th abdominal sternite. Five-locular pores are disposed on the ventral surface of the cephalothorax and on the 2nd - 6th abdominal sternites. Three-locular pores are numerous on the dorsal surface, along the edge of the ventral surface and on the 6th - 8th abdominal sternites. Tubular pores, 9.4 microns long, are disposed in groups together with multilocular pores, and are also found along the edge of the 5th - 8th abdominal sternites, and form transverse rows on the 5th - 7th abdominal sternites. Grouped pores on the dorsal surface and along the edge of the ventral surface are of a somewhat larger diameter (3.1 microns) than the other pores (2.5 microns).

There are 16 pairs of cerarii along the edge of the body, composed of 2 thin conical spines near each other, 15.7 microns in length, and of 1 (seldom 2 or 3) three-locular pore at the base. Three-locular pores which accompany the spines are distinguished from the others throughout the body by a somewhat greater size and by their structure (Fig. 3). Cerarii are found on a convex chitinized protuberance, which becomes smooth with age. There is an additional row of cerarii, resembling those along the body edge, along the mid-line of the dorsal surface; sometimes the spines in some of the thoracic cerarii are placed apart from each other.

Spines on the dorsal body surface are 12.5 - 15.7 microns long(resembling those in the cerarii) are placed on a convex chitinized protuberance and have at their bases 1 three-locular pore. They form a row along the edge of the body, are found on the head, in front of the anterior stomata, and form 4 transverse rows on the thorax, and a tranverse row on the 1st - 7th abdominal tergites. Spinelets are conical, up to 5 microns in length, and are found on all the tergites of the body and along the edge of the ventral surface. Hairs are found on the ventral surface.

Variability. We had at our disposal material collected from heather (Calluna vulgaris Salisb.)from Luga and from the Gromovo station near Priozersk, from crowberry (Empetrum nigrum L.) fromLuga and Priozersk, from bearberry (Arctostaphylos uva ursi Spr.), from strawberry (Fragaria vesca L.) and from Ramischia secunda Garcke from Luga. In addition to this we had an opportunity to use material from heather, collected in Germany (the locality of the first description of the species), which is kept in the collection of the Institute of Zoology AN SSSR.

Because this species was first described from heather, we have used only those insects which were collected from heather for the description given above. When insects from heather from various localities of the Leningrad region were compared with those from Germany, there were no significant differences noted. However, insects from other plants show certain deviations. Thus, in insects from bearberry, strawberry and Ramischia secunda Garke the multilocular pores in groups are more numerous (3-4, more seldom 2 and 5), cerarii with 3-4 pores are also more numerous, cerarii with 1-2 pores (as in insects from heather) are found less frequently. In the insects from bearberry the groups of multilocular pores are also more numerous, as well as ungrouped multilocular and tubular pores on the posterior abdominal sternites.

Biology and distribution. S. calluneti Lndgr., according to its food specialization, is an oligophage. Its basic food plants belong to the family Ericaceae. We collected this species from heather, bearberry, crowberry, whortleberry (Vaccinium myrtillus L.), foxberry (V. vitis idaea L.), bog bilberry (V. uliginosum L.) and cranberry (Oxycoccos quadripetalus Gibib.). In addition to this, the species was noted once on Ramischia secunda Garcke, which belongs to the family Pirolaceae, closest to the heather family, and on strawberry (Rosaceae). The insects live on the subterranean and on the surface stems.

In the Leningrad region this species is found everywhere. It is quite common and often is found in large colonies. It lives in dry pine forest and in heathland, as well as in damp green-moss and sphagnum pine and fir forests.

The eggs winter in loose, white egg sacs. Nymphs are produced in the beginning of June. Males and females appear in the second half of July. Oviposition takes place from August to September. The eggs are yellow. The young forms, resembling females, are pink, and are covered with a white powdery wax, having soft wax plates at the tip of the body.

This species is widely distributed in Western Europe; in the USSR it is known from Latvia.

Systematic remarks. There is no detailed description in the literature. The original description by Lindinger [1912] is devoid of illustrations, brief and incomplete. Consequently, we consider the above description and illustration as useful.

The systematic position of this species was changed repeatedly. In the original description it was placed in the genus Pseudococcus Westw. Goux [1937 b] placed it temporarily in the genus Pedronia Green. Later, Balachowsky [1952-53] included it in the new genus Parapedronis Balach.

According to our opinion, however, the genus Parapedronia Balach is a synonym of the genus Spinococcus Borchs. (Borkhsenius [1949]). The characteristics of the genus Spinococcus Borchs. are the presence of spines with a three-locular pore at their base and of a marginal and a medial row of cerarii, composed of two apposed spines of the same type. Spines which are scattered throughout the body and which enter into the composition of cerarii are placed on a chitinized protuberance which wears off with age. The genus Parapedronia Balach. has the same characteristics, but does not have, according to Balachowsky [1952-53], the chitinized protuberances. We consider this an age characteristic, which disappears in older females.

We cannot agree with Balachowsky [1952-53] that the genus Spinococcus Borchs. is a synonym of the genus Synacanthococcus Morr. (Morrison [1920]). Synacanthococcus Morr. is well distinguished by the presence of sharply defined, strongly chitinized large cerarial plates and by the development of the characteristic cylindrical pores.

Peliococcopsis parvicerarius (Goux), (Fig. 4).

Body elongate-oval, 2.5 mm in length and 1.5 mm in width, light-sandy in color. Antennae 9-membered, short and thin. Average length of antennal segments (in microns): I 21.6, II 38.9, III 21.6, IV 21.6, V 21.6, VI 25.9, VII 21.6, VIII 25.9, IX 43.2. Loop of rostellar setae short, only 1.5 times longer than the rostellum. Legs short with thin segments; posterior coxae without transparent pores, femora about 99.0 microns in length, tibiae 164.2 microns, tarsi 86.4 microns, claws with a small tooth. Abdominal stoma absent. Anal ring roundish, with a double external and a single internal row of small roundish pores and 6 setae about 86.4 microns long. Anal segments well developed, with an apical seta 142 microns long; ventral surface of the segments with a subapical seta 77.8 microns long and several hairs. Both pairs of dorsal stomata well developed.

Discoid pores of three types; multilocular, five-locular and three-locular. Multilocular pores are collected into groups of 3-4 (less often 1-2, 5-6) around a single tubular pore. On the dorsal surface these groups form 3 transverse rows on the thorax, a transverse row on the 1st-8th abdominal tergites, and a row along the edge of the body; On the ventral surface individual groups are found on the thorax, form a transverse row on the 4th abdominal sternite and along the edge of the body, the latter becoming broadened on the abdomen. Ungrouped multilocular pores form transverse rows on the 5th-7th sternites and a band on the 8th abdominal sternite. Five-locular pores are numerous on the dorsal and ventral body surfaces. Three-locular pores are extremely scarce; they are found near the spiracles, dorsal stomata, within cerarii, and singly along the edge of the body; sometimes individual pores may be found on the dorsal surface. Tubular pores, 6.2 microns long and 1.5 microns in diameter, are placed into groups with multilocular pores, and also form a row on the 3rd abdominal sternite. Somewhat larger pores, 9.3 microns long and 2.5 microns in diameter, form transverse rows on the 5th-7th abdominal sternites and are placed along the margin of the 5th-8th abdominal sternites.

Cerarii not numerous. Only C_{16-18} are well developed, they consist of 2 thin conical spines and of three-locular pores. Formula of cerarii: C_{18-17} = 2 spines (15.7 microns) + 4-5 pores; C_{16} = 2 spines (9.2 microns) + 2 pores. Other cerarii cannot be distinguished.

Spinelets thin, up to 6.3 microns in length, numerous, disposed on the dorsal body surface and along the edge of the ventral surface. Hairs are disposed on the ventral surface.

Biology and distribution. Females were collected on July 8th, 1958 at the bases of stems of Poa pratensis L. on a railway embankment near Podporozh'e on River Svir'.

It is known in the south of France, having been first recorded by us from the USSR [1959].

Systematic remarks. In the original description (Goux [1937a] the species was placed in the genus Phenacoccus Sign. But the presence of the characteristic groups of multilocular and tubular pores, as well as the distribution of the five-locular pores on both the body surfaces is clear witness to the belonging of the species to the subsequently described genus Peliococcopsis Borchs. (Borkhsenius [1949]), in which there is only one known species, P. caucasicus Borchs. This species is distinguished from the type species by the small number of cerarii, a smaller number of grouped multilocular pores, the disposition of these groups not only on the dorsal surface, but also along the edge of the ventral surface, and the extreme scarcity of three-locular pores.

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A NEW SPECIES OF THE GENUS SIGARA (HEMIPTERA, CORIXIDAE) FROM TRANSCAUCASIA

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Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 1, pp. 182-186, January-March, 1960

Sigara (Callicorixa) raddei, sp. n.

Sigara (Callicorixa) raddei, sp. n., is a new species very closely related to S. (C.) praeusta (Fieb.) (Jaczewski [1924]; Lundblad [1927]), from which it may be distinguished at first sight by the coloration of the hind tarsi in both sexes. In S. (C.) praeusta (Fieb.) the distal part of the first hind tarsal segment is marked with a large, approximately quadrangular black spot, which occupies the entire width of the segment. In S. (C.) raddei, sp. n., only the inner margin of the first hind tarsal segment is darkened, with a longitudinal stripe which is intensely black on the distal half (Fig. 1).

Facial impression of male (Fig. 2) well developed, extending fairly high between the eyes, where it terminates in an even arc, and occupying entire distance between lower angles of eyes. On the whole the facial impression of this species is perhaps somewhat more pronounced than in S. (C.) praeusta (Fieb.). Like that of S. (C.) praeusta (Fieb.) it is covered with short setae. Length of 4th antennal segment approximately 72.5% length of 3rd.

Pronotal disc with distinct rastration, covered with 9—10 pale transverse stripes which are partly cleft and anastomosing; the pale stripes are somewhat wider than the dark intervals of background color between them. Lateral angles of pronotum obtuse. Lateral lobes of prothorax linguiform, apically rounded.

Hemielytra with distinct rastration which disappears only at distal angle of corium. Pattern of hemielytra (Fig. 3) not differing from that of S. (C.) praeusta (Fieb.)

Xyphus matasterni sagittate, obtusely rounded at apex (Fig. 4).

Anterior legs of male as shown in Fig. 5. Setae at middle of anterior margin at base of femur stout and spiniform, as in S. (C.) praeusta (Fieb.). Pala without the dilation at the terminal portion characteristic of S. (C.) praeusta (Fieb.); its upper margin basally straight and almost parallel with the lower one, then forming an even arc and merging with the short apical margin, which meets the lower one at base of claw. Distal part of pala not twisted at its anterior surface. Row of pegs situated as in S. (C.) praeusta (Fieb.), the distal row running close to palar margin for its entire length. Number of pegs in proximal row 15—20, with a mean of 17.25 for the four palae examined; in the distal row 12. There are 27—32 pegs in both rows taken together, with a mean of 29.25 for the four palae examined. The following

Fig. 1. Sigara (Callicorixa) Raddei, sp. n., hind tarsus (× 20).

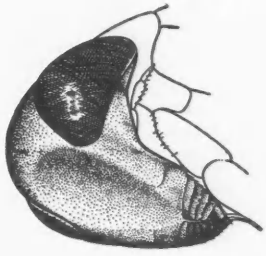

Fig. 2. Sigara (Callicorixa) raddei, sp. n., ♂ head (× 20).

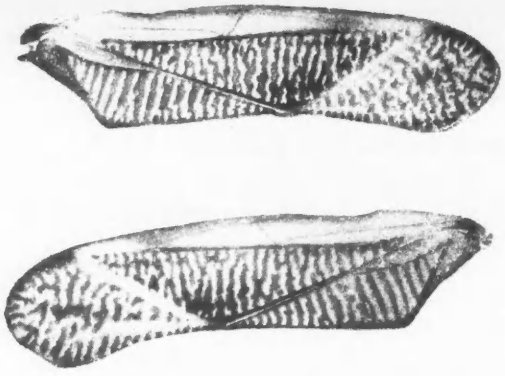

Fig. 3. Sigara (Callicorixa) raddei, sp. n., hemielytra. (×15).

Fig. 4. Sigara (Callicorixa) raddei, sp. n., xiphus metasterni. (× 40).

combination of peg numbers were found in the two rows: 15–12, 16–12, 18–12, 20–12.

The relative lengths of the individual segments of the middle and hind legs, expressed as percentages of the corresponding femur, were as follows:

	femur	tibia	tarsus	claws
Middle legs:	100	46.4	36.9	34.5
	femur	tibia	tarsus I	tarsus II
Hind legs:	100	97.3	113.9	56.25

Femora of middle legs, as in S. (C.) praeusta (Fieb.), with a very few long setae on posterior margin. Claws of median legs somewhat shorter than tarsi. Upper side

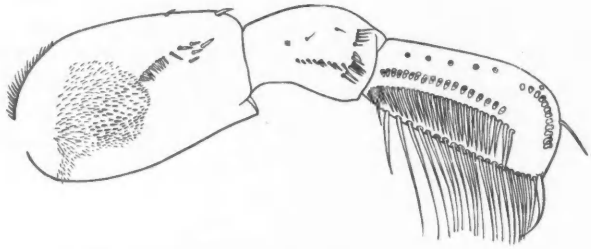

Fig. 5. Sigara (Callicorixa) raddei, sp. n., ♂ foreleg. (× 50).

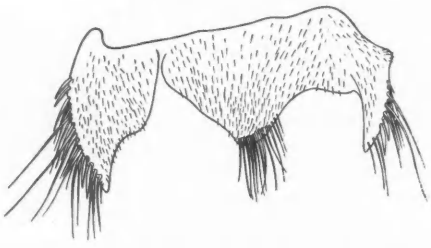

Fig. 6. Sigara (Callicorixa) raddei, sp. n., ♂ seventh abdominal tergite. (× 30).

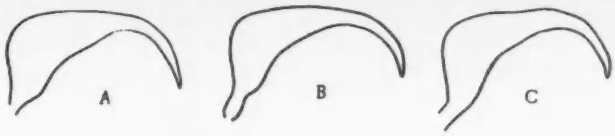

Fig. 7. Sigara (Callicorixa) raddei, sp. n., ♂, right paramere. (× 50). A) Sevan; B) Erevan; C) Leninakan.

of hind femora with 3–4 minute spines, lower side with about 30 spines, as in S. (C.) praeusta (Fieb.). Coloration of first segment of hind tarsi described at the beginning of the paper; second segment pale.

Strigil absent. Median lobe of 7th abdominal tergite somewhat more triangular than that of S. (C.) praeusta (Fieb.), the right margin with an angular process at its basal part (Fig. 6). Right paramere as in Fig. 7, the left paramere apically acute, with a few minute barbs.

Total length: 6.25–7mm.

Armenian SSR: Lake Sevan, Dzhil, July 16, 1923, 2 ♂♂ (Sevan Expedition of the Armenian Museum); Erevan, April 27, 1929, 1 ♂ (Kirshenblat); Leninakan, September 26, 1940, 1 ♀, October 3, 1940, 1 ♂ (Esterberg); Stepanavan, swamp, August 15, 1956, 4 ♂♂, 14 ♀♀ (Akramovskaya). Georgian SSR: Bakuriani, July 5, 1949, 1 ♀ (Kirichenko). Turkey: Kars Vilayet, Ardagan, Okam, Gole, September 3, 1902, 1 ♀ (Satunin).

A microscopical preparation of one of the males collected at Lake Sevan, and preserved in the Zoological Institute of the Academy of Sciences USSR, in Leningrad, has been selected as the holotype. The species has been named after G. I. Radde, the distinguished investigator of the natural history of the Caucasus and Transcaucasia.

Whether S. (C.) raddei, sp. n., is a separate species or only a subspecies of S. (C.) praeusta (Fieb.) is difficult to say without a more detailed study of the geographical distribution and biology of both forms. In any case, all the faunistic records concerning collecting localities for S. (C.) praeusta (Fieb.) in the Caucasus and Transcaucasia require careful verification (e. g., Kirit-shenko [1918] and others).

It is also entirely possible that the data referring to the presence of S. (C.) geblerl (Fieb.) in the Caucasus actually refer to S. (C.) raddei, sp. n. It must be pointed out that the very large amount of material of S. (C.) geblerl (Fieb.) found in the collection of the Zoological Institute of the Academy of Sciences USSR, in Leningrad, does not contain even one specimen from the Caucasus, whereas all of the specimens of S. (C.) raddei, sp. n., listed above were found among this material except those collected on Lake Sevan and in Stepanavan.

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NEW AND LITTLE-KNOWN PALEOARCTIC SPECIES OF THE GENERA HALTICA MULL, AND PHYLLOTRETA FOUDRAS (COLEOPTERA : CHRYSOMELIDAE)

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Haltica bisulcata Wiese

Elongated, slightly convex, violet-blue. Frontal tubercles rounded, almost contiguous, basally convex, shiny, smooth, depressed at the top with an uneven surface; frontal keel narrow, convex, constricted at the top and bottom; labrum slightly recessed, with large punctures; sinciput convex, shiny, slightly wrinkled, with indistinct punctation; first antennal segment twice as long as the second, shiny, smooth; the remaining primary segments up to the 4th inclusively with setae on the surface; beginning with the 5th all the apical segments with dense setae. Promotum 1½ times broader than long, greatest breadth beyond the middle, anteriorly noticeably narrowed at the sides; transverse furrow narrow, weak, and terminates on the sides; punctation fine, dense; intervals between them shagreened. Elytra with the bases a little narrower than the posterior edge of the pronotum, noticeably broadened behind the humeral angles, their greatest breadth beyond the middle; humeral tubercles large, strongly convex, with an acute crease along the sides, which begins at some distance from the humeral angle and terminates without reaching the apex (Fig. 1, a);

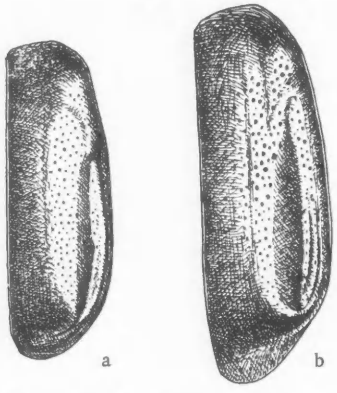

Fig. 1. a) Haltica bisulcata Weise. b) Haltica quercetorum Fdr. (saliceti auct.). Elytra.

punctation fairly fine, dense and irregular, with shagreened intervals. Venter with sparse hairs; first tarsal segment longer than the second and third taken together. Length 4-4.2 mm. The copulatory apparatus is shown in Fig. 2.

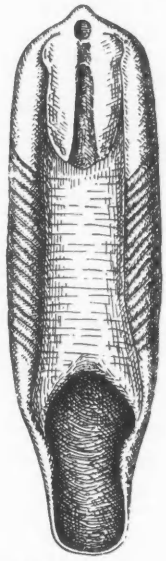

Fig. 2. Haltica bisulcata Weise. Copulatory apparatus.

According to its structure this species is closest to Haltica quercetorum Foudr. (saliceti auct.), and distinguished by its smaller body size, violet-blue coloration, shagreened intervals between punctures and a lateral crease on the elytra (Fig. 1, b). There are significant differences in the structure of the copulatory apparatus, and the lateral creases are equally broadened and the structure of the upper parts is different.

A mass accumulation of the rhododendron flea-beetle was discovered by G. A. Zinov'ev on August 19, 1957 during the USSR Academy of Sciences expedition into the Amur Region (between the Maly Peso and Bol'shoi Ergil' rivers), on an overgrowth of rhododendron (Rhododendron dahuricum) in an oak forest. The beetles and their larvae were causing heavy damage to the rhododendron leaves.

The species type is stored in the collection of the Institute of Zoology of Acad. Sci. USSR in Leningrad.

Phyllotrata ogloblini Shap. sp. n.

Elongated, depressed, blackish-bronze with a silky shine, antennal segments 1-4 yellow, sometimes segment 1 and 4 are darkish dorsally, curved tibia yellow, tarsae brown. Characteristic peculiarity of the species—the strong curving of the tibia of the hind legs. (Fig. 3).

Frontal keel narrow, convex; frontal tubercles indistinct; sinciput and superior half of frons with dense and large punctures. Pronotum slightly than long, its greatest breadth is in the middle, somewhat narrower than the base of the elytra, the sides slightly rounded, punctation on the plate fairly large and dense. Thorax small, transverse, rounded at the apex, smooth. Elytra parallel-sided; the humeral tubercles large and strongly convex, the apices are jointly rounded and leave the apex of the pygidium only slightly uncovered; the punctation large, dense, matted; anteriorly there occur indistinct rows; spaces between punctures convex, smooth. Length 2 mm.

Fig. 3. Phyllotreta ogloblini Shap., sp. nov. Tibia of metathoracic leg.

It is distinguished from its relative Ph. paradoxa Lop. by its unshortened elytra and the construction of their apices, the color of its antennae and legs, and also the construction of its pronotum.

Vicinity of Askania Nova, Khersonsk Region, May 17, 1927 (S. L. Medvedev). Discovered on crucifers.

The species type is stored in the collection of the Institute of Zoology, Acad. Sci. USSR in Leningrad.

The species is named after the well-known Soviet coleopterist D. A. Oglobina.

NEW SPECIES OF THE GENERA SALSOLICOLA KUZNETS., G. NOV., PAMMENE HB., AND LASPEYRESIA HB. (LEPIDOPTERA, TORTRICIDAE) IN THE USSR FAUNA

V. I. Kuznetsov

Translated from Entomologicheskoe Obozrenie Vol. 39, No. 1, pp. 189-199, January-March, 1960

The present paper describes eight new species of leaf rollers (Tortricidae) from the rich collection of the Zoological Institute, AN SSSR. Some of these were reared from larvae on various woody plant species and consequently some biological notes are provided in addition to the descriptions of external appearance and genitalic morphology of the adults.

The species of Pammene Hb. which are described below were discovered as a result of the systematic revision of the Paleoarctic representatives of the dendriphilic genus; this revision will be published later. Two new pests of the important sand-stabilizing cultivation of cherkez (Salsola Richteri), widely distributed in the Central Asian deserts, were separated into a distinct genus Salsolicola Kuznets., g. nov.

The types of the new species are preserved in the collection of the Zoological Institute AN SSSR, in Leningrad.

I am deeply grateful to A. S. Danilevskii for his manifold assistance in accomplishing this work.

SALSOLICOLA KUZNETSOV, gen. n.

Type of genus: Salsolicola rjabovi Kuznetsov, sp. n.

Most closely related to Catoptria Gn. on the basis of the wing venation and possibly related to Gypsonomoides Obr. by the structure of the male genitalia. The moths resemble Semasia ursulana Kenn. in external appearance.

The costal fold is absent in the males. In the forewings, veins M_2 and M_3 issue from a single point; the base of R_1 is nearer R_2 than to the base of the wing. The inner vein of the cell issues between R_1 and R_2, but its base is approximated to R_2. The origins of veins R_1, R_2, and R_3 are unequally separated, R_2 being close to R_3. In the hind wings, veins R and M_1 issue from a single point and M_3 and Cu_1 issue from a common stem or from a single point.

Valva broad, weakly differentiated into a sacculus and cucullus. Internal surface of cucullus bare except for a crest or elevation beneath the apex which is densely covered with spines and a tuft of large chetae. There is a well-developed uncus. Aedeagus with a sclerotized crest. Anal papillae short and broad. Genital opening funnel shaped. No postvaginal sclerites. Seminal duct merging with the short duct of the bursa copulatrix close to the neck of the bursa copulatrix. One signum of very characteristic shape, in the form of a broad crest or invagination which is intruded into the body of the bursa copulatrix.

The larvae live in the rolled leaves of Salsola, developing in the spring in one generation.

The range of the genus comprises the deserts of Central Asia (Turkmenia, Tadzhikistan). Two species are known — S. rjabovi Kuznets., sp. n. and S. stshetkini., sp. n.

KEY TO THE SPECIES OF THE GENUS SALSOLICOLA KUZNETS., GEN. N.

1 (2). Upper brownish-gray streak external to median pale band stretching transversely from the costal to inner edge of wing; M_3 and Cu_1 of hind wing on a common stem; apex of aedeagus with a finely toothed crest; uncus small, unciform; width of sclerotized anellus of genital opening of female equal to half of diameter of duct of bursa copulatrix . S. rjabovi Kuznets., sp. n.

2 (1). Upper brownish-gray streak external to median pale band stretching longitudinally from center of wing to its apex; M_3 and Cu_1 of hind wing issuing from single point; apex of aedeagus with a very large, acuminate process; uncus large, straight; width of sclerotized anellus of female genital opening equal to diameter of duct of bursa copulatrix . S. stshetkini Kuznets., sp. n.

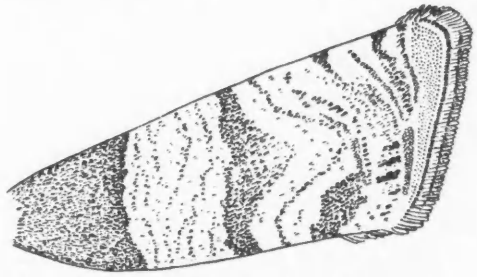

Fig. 1. Salsolicola rjabovi Vl. Kuznetsov, sp. n., diagram of forewing pattern.

SALSOLICOLA RJABOVI Vl. KUZNETSOV, sp. n.

Epiblema sp. Shteinberg, 1954.

Adult (Fig. 1). Wingspread 11.5–16.5 mm, females distinctly larger than males. Shape and type of pattern

of forewing reminiscent of that of Semasia ursulana Kenn. Head, thorax, and patagia white. Palpi whitish with a slight admixture of grayish contiguous scales; consequently they are half as wide as those of S. ursulana Kenn. Basic coloration of forewings white with a brownish-gray pattern, the shading of which is rather variable. The actual base of the wing varies from pure white to a grayish shade; outer edge of basal field, which occupies less than 1/3 of the wing area, is sharply delineated by a darker brownish-gray transverse band which is uneven, straight or slightly curved in toward the wing base (in S. ursulana Kenn. the basal field is paler medially and its outer edge is bent at an obtuse angle). After the broad white median band, which is traversed by three of four wavy brownish-gray lines, there is a large brownish-gray triangular blotch with obtuse angles, forming a transverse belt. One corner of this blotch touches the costal edge behind the middle, the other the hind edge at the middle, while the third is situated on the longitudinal axis of the wing closer to the outer edge. In spite of the fact that in many specimens this third angle is somewhat effaced, the transverse band achieves its maximal width in the region of the longitudinal axis of the wing. On the inner edge anterior to the speculum is a small, similarly colored triangular spot (absent in S. ursulana Kenn.), the apex of which is inclined outwardly. The white interspace between these spots is distinctly divided by dark lines. Externally to the transverse triangular band there are five or six dark streaks on the costal edge which give origin to fine dark stripes which often broaden and merge over the speculum into a common tone which is divided by silvery or whitish lines. Both silvery lines which form the speculum are distinct and there are three or four black spots, one above the other, in the speculum. A fine black line (absent in S. ursulana Kenn.) runs parallel to the outer edge of the wing delineating externally a grayish field which gradually narrows from the apex of the wing to the hind angle. Fringe bicolored, the bases of the scales pale and their tips dark (in S. ursulana Kenn. the fringe is uniformly gray and interrupted at the middle by a wide white section). Subapical spot absent. Hind wings light gray, the fringe whitish with a gray line at the base, veins M_3 and Cu_1 on a common stem.

Genitalia of ♂ (Fig. 2) distinctly different from the male genital apparatus of S. ursulana Kenn. Valva broad, slightly tapering towards apex, weakly differentiated. Upper edge slightly concave, lower with a barely perceptible excision; therefore the cucullus is weakly differentiated. Apex of cucullus rounded. A long fringe extends along the entire valva on the inner surface; on the cucullus it is armed with strong spines, while on the sacculus it consists of fine setae. The free end of the slender aedeagus is unequally sclerotized, the upper surface being more strongly sclerotized than the lower and strengthened by a toothed crest. There are two spines inside the aedeagus. Soccii of the usual form. The developed uncus resembles a small hook.

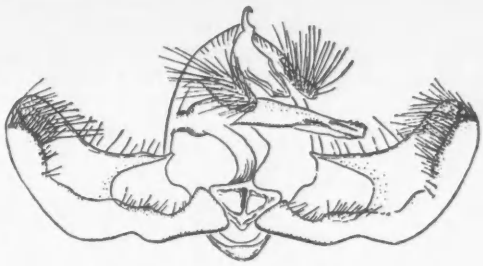

Fig. 2. Salsolicola rjabovi Vl. Kuznetsov , sp. n., ♂ genitalia.

Genitalia of ♀ (Fig. 3). Anal papillae very small and broad, the setae as long as the diameter of the papilla. Posterior apophyses longer than anterior. The poorly differentiated genital plate is tranversely widened. The genital opening is in the form of a wide, weakly narrowing funnel somewhat exceeding the papillae in diameter. Duct of bursa copulatrix sclerotized for almost its entire length to the junction of the seminal duct, with a small membranous portion near the funnel of the genital opening only. The small membranous bursa copulatrix bears one large signum of very characteristic shape which projects into the body of the bursa as a ridge. The length of the signum is greater than the diameter of the duct of the bursa copulatrix.

Material. The species is based on 34 specimens. Holotype: 1 ♂, Kara-Bogaz, 40 km north of Kizil-Arvat, Ashkhabad Region, May 29, 1952, from a larva on cherkez (Salsola Richteri), V. L. Kuznetsov. Allotype : 1 ♀, ibidem, May 30, 1952, from larva on Salsola Richteri, V. L. Kuznetsov. Paratypes : 7 ♂♂, 8 ♀♀, ibidem, May 28—June 2, 1952, from larvae on Salsola Richteri, V. L. Kuznetsov; 1 ♀, ibidem, May 20, 1953, from larvae on Salsola Richteri, V. A. Maslennikova; 1 ♂ , 3 ♀♀, ibidem, May 17 and 21, 1953, at light, V. A. Maslennikova; 2 ♂♂, 5 ♀♀, sands of Sargali, Ashkhabad region, May 22, 1951, from larvae on Salsola Richteri, D. M. Shteinberg; 1 ♀, Bairam-Ali, Marunskaya Region, May 18, 1925, at light; 1 ♂ , 1 ♀, Uch-Adzhi, Marunskaya Region, at light May 18, 1914, M. A. Ryabov; 1♂ , 1 ♀, sands near Bura-Tau, Tigrovaya Valka preserve, Tadzhik SSR, May 15 and 20, 1949, Yu.L. Shchetkin.

Biology. This remarkable species was first discovered in 1914 by the well-known lepidopterist M. A. Ryabov, after whom it was named. It remained undescribed for more than 40 years, even though notes on its biology appeared in the literature (Shteinberg, 1954). In April and May the caterpillars live in characteristic tubes formed of complexly intertwined and spirally twisted leaves of cherkez (Salsola Richteri). Pupation begins in the first ten days of May and takes place inside these tubes. Emergence begins in the second ten days of May , while the flight of the moths lasts until the middle of June. There is only one generation a year. It is distributed along the deserts of southern Turkmenia and Tadzhikistan. Vis-

ible infestations of cherkez were recorded from the Sargali sands in the Meshed—Messerianskaya Plain (D. M. Shteinberg) and north of Kizil-Arvat (V. A. Maslennikova).

Fig. 3. Salsolicola rjabovi Vl. Kuznetsov, sp. n., ♀ genitalia.

SALSOLICOLA STSHETKINI Vl. KUZNETSOV, sp. n.

Adult (Fig. 4). Wingspread of ♂ 15.5 mm, of ♀♀ 13.5—16.0 mm. Closely related to the preceding species. Head, thorax, and patagia white. Palpi broad, as in S. ursulana, but pure white. The basic coloration of the bore wings is white with a brownish-gray pattern. Basal field, occupying 1/3 of the wing area, broader than in S. rjabovi Kuznets, sp. n., whitish ; its outer edge consisting of a distinct, straight, brownish-gray stripe which runs more obliquely than in S. rjabovi Kuznets., sp. n. After the broad white transverse band of the basic coloration, which is divided by one or two fine brownish-gray areas are situated beyond the midle of the wing. One narrow area is drawn out longitudinally from the center of the wing towards the apex , its outer end merging at an acute angle with a narrow grayish band of lighter shade which derives its origin from a black streak beyond the middle of the anterior edge of the wing (in S. rjabovi Kuznets., sp. n., this area is in the form of a large triangle running transversely down to the inner edge of the wing). Opposite to it is a similarly colored triangular area,the base of which lies on the inner edge of the wing and the apex of which is strongly inclined outwardly, such that its upper edge runs parallel to the central longitudinal area and the outer edge of the spot descends vertically to the inner edge of the wing before the speculum. The whitish interval between these brownish-gray areas is divided by a slender dark line. On the costal edge external to the upper area there are seven dark streaks which give rise to dark stripes. The apex of the wing, border, and fringe are the same as those of S. rjabovi Kuznets., sp. n. Hind wings light gray , the fringe whitish with a gray line at the base, veins M_3 and Cu_1 issuing from a single point.

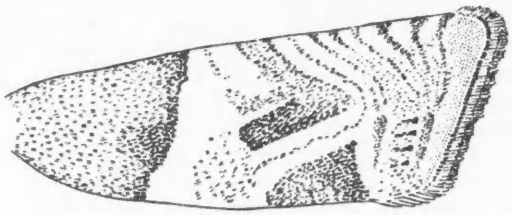

Fig. 4. Salsolicola stshetkini Vl. Kuznetsov, sp. n., diagram of forewing pattern.

Genitalia of ♂ (Fig. 5) similar in general plan to the male genital apparatus of S. rjabovi Kuznets., sp. n., but easily distinguished from the latter by the shape of the valva, aedeagus, and uncus. The valva is broad, the upper margin is slightly concave, and the lower has a shallow excision in the middle. The sacculus ends in a moderately rounded laminate process. A sclerotized crest extends along the inner surface of the sacculus. Slender bristles are scattered along the inner and lower surfaces of the sacculus with one group situated on the crest. The inner surface of the cucullus is almost bare except for the apex, where a group of simple spines and slender bristles is situated on a low prominence. The slender, apically slightly acuminate aedeagus is somewhat longer than the cucullus and of extremely unusual form. Its apical end is dorsoventrally compressed and on the left side bears a ridge which is armed with a long, tapering projection which is turned backward. There are no spines inside the aedeagus. The socii are of usual form. The uncus is more developed than in S. rjabovi Kuznets., sp. n. , and is shaped like a long, almost straight projection which is acute at the end.

Genitalia of ♀ (Fig. 6) very similar to the female genital apparatus of S. rjabovi Kuznets., sp. n. Anal papillae short and broad, length of setae less than diameter of papillae. Posterior apophyses about as long as anterior. The poorly differentiated genital plate is less transversely widened in comparison with that of S. rjabovi Kuznets., sp. n. The genital opening is shaped like a slightly narrowing funnel; the sclerotized ring forming this funnel is two to three times wider than in S. rjabovi Kuznets., sp. n. The duct of the bursa copulatrix is more feebly sclerotized than in S. rjabovi Kuznets., sp. n. The small membranous bursa copulatrix bears one lamellar signum which intrudes slightly into the body of the bursa. The length of the signum is not greater than the diameter of the duct of the bursa copulatrix.

Material. The species is based upon 12 specimens. Holotype (1 ♂) and paratypes (2 ♂♂, 1 ♀) : sands near Bura-Tau, Tigrovaya Valka Preserve Tadzhik SSR, May 18, 1949, from larvae on Salsola Richteri, Yu. Shchetkin.

Fig. 5. Salsolicola stshetkini Vl. Kuznetsov, sp. n., ♂ genitalia.

Allotype 1 ♀ , Akhcha-Kuima, Ashkhabad Region, June 3, 1953, at light, V A. Maslennikova. Paratypes : 1 ♀, ibidem, June 3, 1953, at light, V. A. Maslennikova, 6 ♀♀ Shasenem, northern Kara-Kumy, Tashauzskaya Region, June 4—5, 1953, at light, A. Kir'yakova .

This species has been named after the lepidopterist Yu. L. Shchetkin.

Fig. 6. Salsolicola stshetkini Vl. Kuznetsov, sp. n., ♀ genitalia.

Biology. As in the preceding species, S. shtshetkini Kuznets., sp. n. , is associated with Salsola Richteri, and possibly also with other species of the genus Salsola. The caterpillars live in rolled leaves and form only one generation. The flight of the moths is observed from the end of May to the beginning of June and was especially massive in the Northern Kara-Kumy according to the data of A. Kir'yakova. In the Prekopetdag Plain it is encountered more rarely than the preceding and evidently causes little damage.

PAMMENE TAURIANA Vl. KUZNETSOV, sp. n.

Adult. Wingspread 10.5—12.0 mm. Closely related to P. splendidulana Gn. Head and palpi covered with black scales with white tips. The basic coloration of the forewings consists of black or blackish-brown scales with white tips. There is no transverse shiny field at the base of the wing such as there is in P. splendidulana Gn.; the base is covered with the same white-tipped black or blackish-brown scales which make up the basic coloration. There is no dorsal spot. The band which occupies its place is dull and grayish. The bases of the costal streaks are white. The metallic lines which form the speculum are broad, leaden, and shiny. Between the speculum and the median transverse band (at the edge of the speculum) there are one or two black spots. There is usually no subapical dot. A slender black line runs along the outer margin of the wing. The fringe is dark-brown and shiny. The hind wings are brownish-gray. The basal half is more strongly colored than in P. splendidulana Gn. The fringe is whitish with a brownish line at the base.

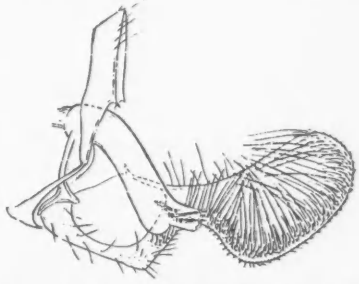

Fig. 7. Pammene tauriana Vl. Kuznetsov, sp. n., ♂ genitalia.

Genitalia of ♂ (Fig. 7). The excision at the lower margin of the valva is sharp and deep. The hind of the sacculus is almost straight. The cucllus is oval and longer than that of P. splendidulana Gn. Length of aedeagus equal to that of cucullus. Aedeagus of even thickness, bent down in an S-shape, with a stout blind

projection at the apex. Apical end of aedeagus about equal in thickness to the blind process (in P. splendidulana Gn. the apical end of the aedeagus is two to three times thicker than the blind process). On one of the males investigated there were two spines on the turned-up part of the aedeagus (in P. splendidulana Gn. there are five or six spines).

Fig. 8. Pammene tauriana Vl. Kuznetsov, sp. n., ♀ genitalia.

Genitalia of ♀ (Fig. 8). Structure of anal papillae, vaginal plate, duct of bursa copulatrix, and signum the signum the same as in P. splendidulana Gn., only the strongly transverse genital plate is somewhat wider. The greatest difference is in the structure of the genital opening and the sclerites associated with it. The sclerotized margins of the genital opening, running into the posterior wall, form an oval postvaginal plate which is longer than wide (in P. splendidulana Gn. the postvaginal sclerites are strongly stretched out laterally and hence the postvaginal plate formed by them is wider than long). The seminal duct where it runs into the duct of the bursa copulatrix is wider than in P. splendidulana Gn.

Material. Holotype: 1 ♂, Bel'bek, Crimean Region, April 19, 1909, V. Pliginskii. Allotype: 1♀, Sevastopol, Crimean Region, March 20, 1909, V. Pliginskii. Paratypes: 2♀♀, ibidem, from larvae on oak, V. Pliginskii.

PAMMENE ORIENTANA Vl. KUZNETSOV, sp. n.

Adult. Closely related to P. gallicolana Z. but distinctly larger, with a wingspread of 15.5—18.0 mm. Frons brownish. Second palpal segment whitish, outwardly fringed half-way around with a band of blackish scales, sometimes blackish scales covering the entire apical outer half of the segment (in P. gallicolana Z. the 2nd palpal segment is yellowish white with two small spots of blackish-brown scales; the first at the apex of the segment, the second on the outer side at the middle). Third palpal segment outwardly blackish.

Coloration of forewings the same as in P. gallicolana Z. but somewhat darker, of an uneven dark-brown shade with blackish transverse streaking alternating in the basal field with silvery-plumbeous stripes. A distinct white dorsal spot with dark scales or spots inside it, of irregular shape, is situated at the middle of the hind edge of the wing and is wider than high. Several of the whitish costal streaks are divided by dark lines. Shiny metallic lines issue from the costal streaks. Speculum distinct, outlined by shiny silvery scales, with three or four black dots inside it. Hind wings colored as in P. gallicolana Z., lighter than the forewings, brownish, becoming lighter at the bases, the fringe grayish-white with a dark-brown line at the base.

Fig. 9. Pammene orientana Vl. Kuznetsov, sp. n., ♀ genitalia.

Genitalia of ♀ (Fig. 9) are most similar to those of P. gallicolana Z. although the differences are considerable. Anal papillae somewhat larger than those of P. gallicolana Z.; the length of the setae somewhat exceeding the width of the papillae. Genital plate with a very large and smooth semicircular excision on the hind margin, its lateral margins without excisions. Genital opening in the form of a narrow half-ring, the sclerotized edge of which runs into the posterior wall above, forming a vaginal plate, and with the lower margin of the genital opening bent forward. Duct of bursa copulatrix about twice as wide as

in P. gallicolana Z. and bearing a weakly sclerotized ring. Signa larger than in P. gallicolana Z.

Material. Holotype: 1 ♀, Klimoitsi, 40 km west of Svobodno, Amur Region (interfluvium of the L. Pera and B. Érgel), March 21, 1959, from larvae on Mongolian oak, I. L. Sukhareva. Paratypes: 2 ♀♀, ibidem, June 24, 1958, G. A. Zinov'ev June 17, 1958, I. L. Sukhareva; 1 ♀, Yakovlevka, Primorskii Dist., June 3, 1926, A. M. D'yakonov, and N. N. Filip'ev.

Biology. Unlike P. gallicolana Z., the larvae of which live in galls of cynipids on common oak, the new species attacks acorns of the Mongolian oak (Quercus mongolica). It is apparently a considerable pest. Adult flight is in June. The development of the larvae in acorns extends into autum. At the end of August to September the larvae leave the acorns and overwinter. Pupation is in spring. There is one generation.

PAMMENE SUBSALVANA Vl. KUZNETSOV, sp. n.

Outwardly similar to P. salvana Stgr., but morphologically forming one group with P. griseomaculata Kuznets, sp. n., which is described later.

Adult. Forewing-spread 12 mm. Palpi covered with whitish, and head covered with brownish-gray, scales with white tips. Basic coloration of forewings grayish brown. At the location of the dorsal spot there is a dull plumbeous gray band beginning before the middle of the anterior edge and, bending at an obtuse angle at the wing axis, continuing out to the middle of the inner edge. At the anterior and inner edges the wing is marked with a dark dividing streak. Costal streaks distinct, white; the intervals between them blackish-brown. Many of the costal streaks are subdivided by broad dividing lines, consequently they number no less than seven from apex of the wing to the transverse band; dull grayish stripes issue from their apex. A fine black line extends along the outer edge of the wing and is interrupted only by the white subapical spot. The metallic lines forming the speculum are dully plumbeous; the speculum contains three black lines. The fringe is almost uniformly brownish-gray. Hind wings grayish-brownwith a lighter base. Fringe white with a brownish line at the base.

Genitalia of ♂ (Fig. 10). Valva with a very large excision at the lower edge; consequently the width of the neck is somewhat less than the diameter of the aedeagus. Upper edge of valva straight. Length of sacculus less than width of valva at its base. Lower angle of cucullus drawn out into an extemely long process covered with sparse fine bristles. Aedeagus stout, slightly S-shaped, with a blind process at the apex. Width of the open end of the aedeagus greater than width of blind process. On the bent portion of the aedeagus there is only a group of approximated spines (about ten).

Material. Holotype: 1 ♂, Anikina Shilka (Priamur ?), May 20, 1877 (collector unknown). Allotype (1 ♀) and paratypes (13 ♂♂, 8 ♀♀): Klimoutsi, Amur Region, May 19, June 8, 1958, V. I. Kuznetsov.

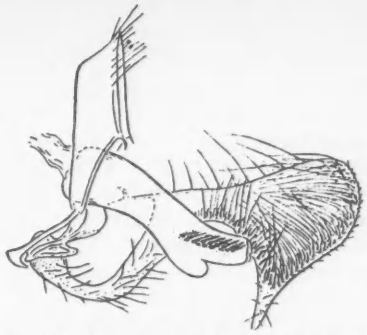

Fig. 10. Pammene subsalvana Vl. Kuznetsov, sp. n., ♂ genitalia.

PAMMENE GRISEOMACULATA Vl. KUZNETSOV, sp. n.

Outwardly similar to P. fimbriana Hw. but morphologically very close to P. subsalvana Kuznets., sp. n.

Adult. Wingspread 12.5–14.5 mm. Coloration of head and palpi as in P. fimbriana Hw. Anterior wings narrow, the basic coloration uneven brownish-gray, but lighter than in P. fimbriana Hw. The narrow, oblique dorsal spot lies on the middle of the inner edge of the wing, its apex inclined outwardly. Dorsal spot indistinct, usually marked by a dark-gray dividing line. The numerous costal streaks indistinct, short, grayish. A dark line, usually interrupted by a pale subapical spot, extending parallel to the outer edge of the wing. A few of the scales of the uniformly shiny gray fringe opposite the subapical spot have pure white tips. Metallic lines dull, plumbeous, the speculum formed by them containing two or three indistinct, dark streaks or dots. Speculum outwardly not bordered by a white stripe as in P. fimbriana Hw. sometimes with only a pale spot over the inner angle of the wing. Base of hind wings grayish, darker than in P. fimbriana Hw., the lower edge and apex brownish-gray In comparison with P. fimbriana Hw. the hind wings appear more monotone. Fringe light, grayish, with a darker brownish line at the base.

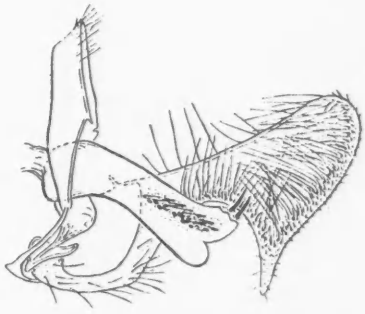

Fig. 11. Pammene griseomaculata Vl. Kuznetsov, sp. n., ♂ genitalia.

Genitalia of ♂ (Fig. 11). Structure of valva and shape of aedeagus very similar to those of the male genital apparatus of P. subsalvana Kuznets., sp. n. Valva of the same shape as in P. subsalvana Kuznets., sp. n., with a very large excision on the lower margin and a straight upper margin, and a long drawn-out process at the lower angle of the cucullus. This process is covered with sparse fine bristles. Cucullus longer than in P. subsalvana Kuznets., sp. n. Aedeagus stout, slightly S-shaped, with a blind process below the apex. Unlike P. subsalvana Kuznets., sp. n., the width of the open end of the aedeagus is equal to that of the blind process and the bent portion of the aedeagus bears two large spines as well as the approximated smaller spines.

Fig. 12. Pammene griseomaculata Vl. Kuznetsov, sp. n., ♀ genitalia.

Genitalia of ♀ (Fig. 12). Anal papillae broad, the length of the bristles equal to the diameter of the papilla. There is a very characteristic genital plate which is strongly transverse, therefore its width is several times greater than its length, which is approximately equal to the diameter of the genital opening. The sclerotized margins of the genital opening merge with the posterior wall forming an elongated postvaginal plate. The duct of the bursa copulatrix is sclerotized in the form of a broad ring. The sclerotization extends a little even to the seminal duct.

Material. The species is based on 14 specimens. Holotype (1 ♂) and allotype (1 ♀): Yakovlevka, Primorskii territory, May 2, 1926, A. M. D'yakonov, and N. N. Filip'ev. Paratypes: 3 ♂♂, 8 ♀♀, ibidem, May 1-4, 1926, A. M. D'yakonov, and N. N. Filip'ev; 1 specimen (without abdomen), Suchan, Primorskii territory, April 26, 1928, A. I. Kuznetsov.

Fig. 13. Laspeyresia grunini Vl. Kuznetsov, sp. n., ♀ genitalia.

LASPEYRESIA GRUNINI Vl. KUZNETSOV, sp. n.

The placing of this new species in the genus Laspeyresia Hb. is based on the structure of the female genitalia. Since no males of this species are known, its systematic position must remain provisional.

Adult. Wingspread 10 mm. Palpi grayish. Basic coloration of the narrow forewings brownish-gray. Dorsal spot apparently not formed (the wing is damaged in the region of the dorsal spot). Costal streaks at apex of wing distinct, white. Third and fifth streaks divided by dark lines and giving rise to two long, shining violet stripes directed towards the outer edge of the wing. Subapical spot and two others behind it pale. Speculum formed of shiny, broad silvery lines and containing three short dark streaks. Fringe almost uniformly brownish-gray. Hind wing with basal half pure white and apical part brownish with a light-brown fringe.

Genitalia of ♀ (Fig. 13) very characteristic, relating this species to L. gallicana Gn. Anal papillae of the usual structure. Genital opening situated at the bottom of a wide funnel-shaped invagination under the genital plate. This invagination of large diameter is unevenly sclerotized; it is particularly strongly sclerotized along the edge. The genital opening is in the form of a funnel of lesser diameter placed within this large funnel-shaped invagination. The lateral edges of the genital opening merge into the posterior wall, forming a small postvaginal plate which is longer than wide. The form of the genital plate is also very characteristic: There are three semicircular excisions along the posterior margin and the

lateral margins are slightly convex. The slender duct of the bursa copulatrix bears a small sclerotized ring, the length of which is about equal to its diameter.

Material. Monotype: 1 ♀, Ternei, Primorskii Territory, May 17, 1941, from the larva; K. Ya. Grunin.

Biology. The larvae live in galls on Mongolian oak (Quercus mongolica).

LASPEYRESIA LARICICOLANA Vl. KUZNETSOV, sp. n.

Adult. Closely related to L. pactolana Z. but smaller, with narrower wings, and differing strongly in coloration. Wingspread of ♂♂ 8.5—10.5 mm, of ♀♀ 11.0—12.5 mm. Head, thorax, patagia and the basal field of the forewings which occupy less than 1/3 of the wing area, paler than in L. pactolana Z., light-gray, shiny. Outer edge of basal field marked by a fairly distinct blackish line (absent in L. pactolana Z.), which is bent at a right angle at the long axis of the wing and which descends perpendicularly to the inner edge of the wing. There follows a broad, pure-white median transverse band which is bent back at an obtuse angle and divided by a fine, interrupted, blackish line which is broken up into individual spots. This transverse band broadens towards the inner edge, where its width is equal to almost 1/3 of the length of the inner edge (in L. pactolana Z. this width is 1/2 to 1/3 of this and is strongly effaced). The following blackish-brown and bent transverse stripe, becoming contiguous outwardly with one of the silvery lines with a bluish tinge which delimit the clearly distinct speculum, is narrower than in L. pactolana Z. The background color of the wing apex, as in L. pactolana Z., consists of dark-brown scales with pale tips, but there is also a large admixture of pure-black scales which make the wing apex appear darker than that of L. pactolana Z. There are five or six black streaks inside the speculum. At the apical half of the costal edge there are five white costal streaks; the most apical one is usually subdivided by a black line. The third and fifth costal streaks (counting from the wing apex) give rise to silvery lines. An intense black line runs along the outer edge of the wing and is interrupted by small white subapical dots and two other white ones beneath it. Fringe uniformly gray, shiny. Hind wings gray, somewhat paler at the base, the fringe whitish with a gray line at the base.

Genitalia of ♂ (Fig. 14) are so similar to those of L. pactolana Z. that reliable differences could not be found. The neck of the valva has a deep depression inside and a distinct semicircular excision on the inner margin, but the depth of this excision is less than in L. pactolana Z. Cucullus oval, somewhat shorter than that of L. pactolana Z. Both the neck of the valva and the adjacent rather unusually low angle of the cucullus are bare, the apical part of the cucullus being densely covered with bristles and setae. Sacculus short, its lower angle bearing a tuft of about 20 long chetae and setae along the lower edge. Aedeagus longer than cucullus, slightly swollen at the base, tapering towards the end, the apex unevenly sclerotized; the sclerotization of the upper surface terminating in a point. Lower surface of aedeagus at apex with a gap through which protrudes the inside part of the aedeagus, which is armed with two groups of minute spines. In the specimen examined there were four spines in one group and 15—17 in the other.

Genitalia of ♀ (Fig. 15) also similar to the female genital apparatus of L. pactolana Z. Anal papillae of moderate width, the length of the setae somewhat exceeding the diameter of the papillae. Genital plate of the same characteristic shape as that of L. pactolana Z., with an even anterior margin, a smooth semicircular excision on the hind margin, and convex lateral margins. Median part of genital plate situated under the duct of the bursa copulatrix characterized by a broad oval shape with an emargination on the hind margin, the width of this area being approximately equal to the length. Genital opening shaped like a rather narrow funnel. Edges of genital opening merging into the posterior wall, forming a flat, regular, but strongly sclerotized postvaginal plate, wider than long, with its hind edge almost straight and its anterior edge with two small semicircular excisions. Sclerotization of genital opening extends uninterruptedly down along the right surface of the duct of the bursa copulatrix, becoming interrupted by a membranous portion only anterior to the point of attachment of the seminal duct. The seminal duct runs down and to the right; in the area of its fusion over the center of the genital plate the seminal duct and the duct of the bursa copulatrix are once again strongly sclerotized, the extent of the sclerotization of both ducts being about equal, or the

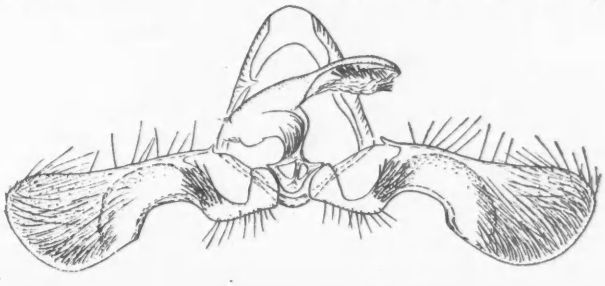

Fig. 14. Laspeyresia laricicolana Vl. Kuznetsov, sp. n., ♂ genitalia.

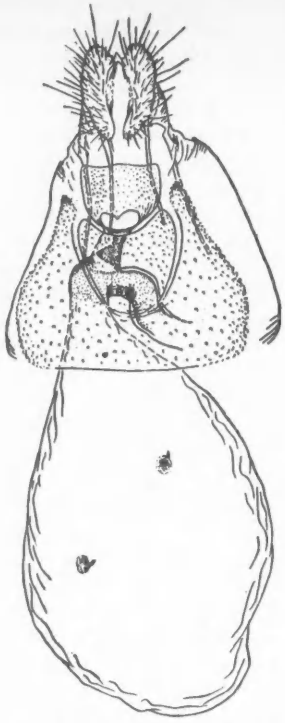

Fig. 15. Laspeyresia laricicolana Vl. Kuznetsov, sp. n., ♀ genitalia.

sclerotization of the seminal duct being longer. The membranous bursa copulatrix is armed with two small signa.

In L. pactolana the sclerotization of the lower surface of the duct of the bursa copulatrix is not interrupted by a membranous portion before the point of attachment of the seminal duct; the seminal duct runs down and somewhat to the left, and the signa are larger.

Material. The species is based on 22 specimens. Holotype: 1 ♀, Klimoutsi, 40 km west of Svobodno, Amur Region, June 24, 1958, V. I. Kuznetsov. Allotype: 1 ♂, ibidem, June 10, 1958, V. I. Kuznetsov. Paratypes: 3 ♂♂, 12 ♀♀, ibidem, June 17—27, 1958, V. I. Kuznetsov; 1 ♀, environs of Irkutsk, July 26, 1936, D. Florov; 1 ♂, 1 ♀, Usugli, Tungokochenskii Dist., Chitinsk Region, June 23, 1958, from larvae on Dahurian larch, M. A. Lur'e; 2 ♀♀, ibidem, June 24, 1958, from larvae on Dahurian larch, L. G. Bogatyreva.

Biology. A common pest species in the Transbaikal and Priamur. Unlike L. pactolana Z., the larvae of which attack the common spruce, the new species is associated with Dahurian larch (Larix dahurica), showing a similarity to the North American L. laricana Busck., the larvae of which live in another species of larch (Larix occidentalis). For the most part young trees are attacked. The larvae chew winding passages in the cambium, these sometimes widening in area. Pupation takes place in the beginning of June. Flight is rather extended, lasting from June 17 to August 8. During the evening hours the moths circle in large numbers over sunlit young larches. They are apparently not attracted to light. In the Amur region this species prefers the edges of oak-larch woods. In the Chitinsk region, according to M. A. Lur'e and L. G. Bogatyreva, it causes serious damage in cut grass-larch plots on sunny slopes.

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ROBBER FLIES OF THE GENUS OMMATINUS BECKER (DIPTERA, ASILIDAE) IN THE USSR

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Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 1, pp. 200-204, January-March, 1960

The asilid genus Ommatinus is predominantly tropical in distribution; only two species of this genus have been known from the Paleoarctic until now: O. tenellus van der Wulp from south-eastern Iran, Aden, and Egypt (from the littoral of the Red Sea) and O. striatus Efflatoun from Egypt. In recent years members of the genus Ommatinus have been discovered in the Transcaucasus and the Far East, in the USSR. Descriptions and a key to the Paleoarctic species of this genus are presented below. The types of the species described are in the collection of the Zoological Institute AN SSSR, in Leningrad.

OMMATINUS STACKELBERGI V. RIKHTER, sp. n.

Head wider than mesonotum. Face flat, without facial tubercle, with dense yellowish-white tomentum. Frons and vertex also tomentose, only the vertical tubercle bare, black, with two long white bristles and several white setae on the surface. Facial beard white, not very dense, consisting of long bristles arranged in its upper part in two rows with smaller setae between them, situated at a distance from base of antennae equal to length of first antennal segment. Beak black. Whiskers dense, white. Antennae black, their segments with a sparse white tomentum, the two basal segments with bristles near apex; 2nd segment shorter and somewhat wider than 3rd; 3rd segment conical, shorter than 1st and 2nd segments combined; arista longer than all three segments combined, bearing on its ventral surface 16-18 long black bristles arranged in two rows. Occipital bristles white in ♂ and black in ♀, strong, with the ends bent forward.

Entire thorax, its pleurae and scutellum, grey tomentose. Disc of mesonotum with six large, distinct, black shining spots with the following outlines: two long and narrow black spots situated along the midline of the mesonotum and divided by a narrow tomentose stripe; they reach the anterior edge of the mesonotum and extend back beyond the line of the transverse suture; two oval spots anterior to the transverse suture located outside the first pair of spots, and two triangular ones behind these, behind the transverse suture; the latter spots are smaller than the preceding and each is drawn out backward into a long narrow stripe which reaches the postalar tubercles. Apex of tegulae black, shiny. Dorsocentral bristles white in ♂ and black in ♀, well developed, one or two shorter pairs extending back beyond the line of the transverse suture. Mesonotum, except for the black, shiny spots, and all pleurae, with erect white setae. Bristles (two presutural, one supra-alar, and one postalar) white in ♂ and black in ♀. Scutellum covered with dense, long, white, erect setae, with two long bristles and several fine setae along the hind margin.

Femora black with white setae, bearing black and white bristles; tibiae yellow, anteroventrally with a black stripe in the ♂ and yellow with a dark apex in the ♀. All tibiae with golden setae and black and white bristles. Tarsae black with a reddish basal segment, with short black bristles, covered below with very dense, short rufous setae.

Wings pale, faintly yellowish, with black veins; crossvein r-m situated closer to the distal end of the discoidal cell. Halteres yellow with darker bases.

Abdomen black, covered with a grey tomentum, somewhat laterally compressed, parallel-sided. Lateral portions of first two tergites and surface of first four sternites covered with long white setae. Surface of remaining tergites and posterior sternites with short white setae. In the ♀ the two terminal tergites have black setae.

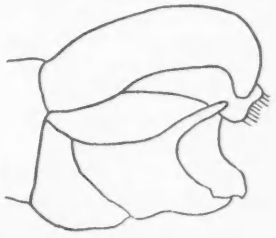

Fig. 1. Ommatinus stackelbergi V. Rikht., sp. n. Hypopygium.

Hypopygium of ♂ (Fig. 1) black, with red gonopods and pale setae. Epandrium oblong, narrowing apically, where both of its halves taper and curve down. Gonopods massive, almost quadrate at base, acuminate and turned up apically; a long slender process, directed upward and backward, issues from their upper margin. 9th sternite large, trapezoidal, feebly excised at the posterior margin.

Total length 12 mm; wing length 8 mm.

Shatin village, Ekheknadzorskii Dist. (Armenia). 1 ♂, July 11, 1959 (V. Rikhter) — holotype. 18 km from Goris on the Kafan road, Vorotan River gorge, Armenia, 1 ♀, June 24, 1959 (V. Rikhter) — allotype.

Closely related to O. tenellus v. d. W., from which it differs by the following characters: distance between beard and base of antennae equal to the length of the first antennal segment; crossvein r-m situated closer to the distal end of the discoidal cell; femora black; epandrium of hypopygium without long processes at the apex; upper margin of gonopods with a long slender process directed upward and backward.

OMMATINUS AMURENSIS V. RIKHTER, sp. n.

Face flat, without facial tubercle, with dense golden yellow tomentum, frons and vertex with less dense yellow tomentum; vertical tubercle shining, black, with two long, intensely black bristles and a number of black setae. Facial beard black (with a few white bristles only in its lower portion), not very dense, consisting of long bristles arranged in its upper portions in two rows with shorter setae between them, located at a distance from the antennal bases which is equal to the length of the first antennal segment. Beak black, whiskers sparse, white. Antennae black, the segments with sparse pale tomentum, the two basal segments bearing setae near the apex; 2nd segment shorter and somewhat wider than 1st; 3rd segment conical, shorter than 1st and 2nd combined. Arista longer than all three segments combined, black, shiny, bearing 12-14 long black bristles, arranged in two rows on the ventral surface. Occipital bristles black, apically bent forward. Mesonotum thoracic, pleurae, and scutellum with light grey tomentum; black shiny spots on disc of mesonotum, except for the bare tegulae, absent. On the tomentose mesonotum it is possible to distinguish a more densely tomentose stripe down the middle which is divided at the anterior portion of the disc by a narrow black stripe, and a densely tomentose spot between the tegulae and the tomentose stripe. Dorsocentral bristles strong, black; two or three shorter and more slender pairs extend back beyond the transverse suture. Fringe of mesonotum rather sparse, consisting of short setae; thoracic pleurae with pale erect setae. Bristles of mesonotum (2 presutural, 2 supra-alar, and 1 postalar) black. Scutellum bearing along the posterior edge 2 strong black bristles (4 in one specimen) and several pale setae; its surface sparsely covered with pale erect setae.

Legs with sparse pale setae and armed with long black and pale bristles. Femora black; tibiae usually black, dorsally with a not very distinct reddish-brown stripe, sometimes reddish-brown or black. Hind tibiae postero-ventrally and tarsi below with very dense golden setae. Tarsi black, with strong black bristles, sometimes with the first segment reddish brown, rarely the tarsi brown.

Wings almost entirely faintly fuscous or lighter, but with a distinctly darker apex. Crossvein r-m situated closer to the distal edge of the discoidal cell. Halteres yellow, with a darker base.

Abdomen black, the posterior margins of the tergites rarely whitish, with a sparse greyish tomentum and short pale setae, only the first two tergites laterally and the four anterior sternites covered with long pale bristles.

Hypopygium of ♂ (Fig. 2) black, shiny. Both halves of epandrium narrowing from base to apex, long, narrow, bent backward and obliquely truncated at the apex, with a small depression; outer angle of apex acute, prominent. Gonopods broad at base, sharply narrowing towards apex, which is narrow, long, bent up and almost contigous with the apices of the epandrium. Ninth sternite broadly excised on the hind edge.

Total length 7-9 mm. Wing length 5-7 mm.

Simonovo, 75 km west of Svobodno, Amur Region, 12 ♀♀, and 5 ♂♂, July 8—August 9, 1959 (Borisova, Zinov'ev, Kerzhner), including the holotype ♂ —July 8, 1959 (Kershner) and allotype ♀— July 9, 1959 (Zinov'ev); Samodon peninsula, 100 km west of Svobodno, Amur Region, 1 ♀, August 6, 1959 (Borisova); interfluvium of Malaya Pera and Bolshoi Érgel', Amur Region, 1 ♀, July 7, 1958 (Zinov'ev, Shubin).

Differs from the other Paleoarctic species of the genus by the absence of shiny black spots on the mesonotal disc, the golden-yellow tomentum covering the face, the black femora and abdomen, and also the long, narrow, apically bent gonopods and epandrium.

Judging by the description, O. amurensis is similar to O. nigripes Becker from the island of Taiwan. From the latter species O. amurensis differs in the following characters: mesonotum without merging brown spots (present in O. nigripes); face with golden-yellow tomentum (in O. nigripes the facial tomentum is grayish yellow); facial beard in its lower part with 2-3 pale bristles (in O. nigripes the beard is entirely black); legs with long, strong bristles, tibiae dorsally with a reddish-brown stripe; anterior tibiae without golden setose fringe on their ventral surface (in O. nigripes the leg bristles are few and weak; the legs are uniformly black; the anterior tibiae have a golden setose fringe on the ventral surface).

The genus Ommatinus, established by Becker [1925a], is characterized by the following features: arista ventrally

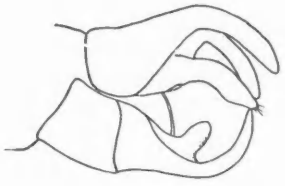

Fig. 2. Ommatinus amurensis V. Rikht., sp. n. Hypopygium.

Fig. 3. Ommatinus amurensis V. Rikht., sp. n. Antenna.

with long bristles arranged in two rows (Fig. 3); face narrow, its width not exceeding the length of the two basal antennal segments combined and almost equal for the entire extent of the face; beard not reaching the bases of the antennae, the setae comprising its upper part sparse and arranged in two rows.

KEY TO THE SPECIES*

1 (4). Mesonotum with gray tomentum, with several distinct, shiny black spots on disc.

2 (3). Distance between beard and bases of antennae equal to length of two basal antennal segments combined; wings hyaline; crossvein r-m situated over middle of discoidal cell. Femora, except apices, reddish-yellow. Both halves of epandrium of hypopygium with a narrow, straight yellow process; gonopods with ends bent upward, without process. Length 7.1—8.9 mm. South-east Iran, Aden, Egypt. . . . . O. tenellus v. d. W.

3 (2). Distance between beard and bases of antennae equal to length of basal antennal segment. Wings yellowish, crossvein r-m situated closer to distal end of discoidal cell. Femora black. Both halves of epandrium of hypopygium without long processes, apically acuminate and bent down. Gonopods at upper margin apically with a long, slender process directed upward and backward. Lenght 12 mm. Armenia . . . . . O. stackelbergi, sp. n.

4 (1). Mesonotum with gray tomentum, without distinct, shiny black spots on disc, or bare with very sparse whitish tomentum.

5 (6). Face covered with white, shiny tomentum. Mesonotum black, fairly shiny with very sparse whitish tomentum; thoracic pleurae without bristles. Crossvein r-m situated considerably closer to base of discoidal cell. Legs reddish-yellow with only apices of femora laterally and tarsi, except basal segment, dark, brownish. Abdomen black with reddish-yellow posterior portions of tergites. Both halves of epandrium of hypopygium narrow, dividing into two sections at their basal third; upper section almost straight, long and narrow, somewhat laterally compressed and terminating in a short downwardly bent spine; lower section half as long as upper, narrow, distally dorsoventrally depressed, below apically with rows of short but strong, straight setose bristles. Gonopods somewhat longer than lower section of epandrium, dorsoventrally compressed, linear, not broadening apically, where they are rounded and feebly bent outwardly. Length 10—11.4 mm. — Egypt . . . . . O. striatus Effl.

6 (5). Face with golden yellow tomentum. Thoracic pleurae with sparse, pale, erect setae. Mesonotum with gray tomentum. Crossvein r-m situated closer to distal end of discoidal cell. Femora black. Abdomen black, tergites sometimes with whitish hind margins. Halves of epandrium of hypopygium long, narrow, not branching into sections, apically obliquely truncated along margin and bent down. Gonopods narrowing sharply from base to apex, long, turned upward. Length 7—9 mm. — Amur region . . . . . O. amurensis, sp. n.

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*Descriptions of O. tenellus and O. striatus based on Efflatoun [1934].

NEW PALEOARCTIC SPECIES OF SYRPHIDAE (DIPTERA) FROM THE FAR EAST

N. A. Violovich

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The present paper consists of a description of 4 new species of flies belonging to the family Syrphidae; these were collected by the author during 1956-57 on Sakhalin Island, Moneron Island and the Kamchatka peninsula.

CHEILOSIA TSHYL, sp. n.

This species belongs to the same group as Ch. dombressonensis Beck., Ch. pagana Mg. and Ch. hercyniae Lw. (Sack [1932:41, 44]) but differs from them in having black, 3-jointed antennae.

Male. Face glossy black, with a scarcely noticeable whitish bloom; median facial prominence extends well beyond the base of the antennae and the margin of the mouth (Fig. 1, A); subantennal depression slanting in profile. The distance from the base of the antennae to the middle of the facial prominence is twice that from the facial prominence to the mouth.

Genae narrow, bearing a few, colored, projecting hairs. Frons black, glossy with long black hairs; there is a centrally situated, deep, rhomboidal depression on the frons. Eyes naked; the length along which the eyes are in juxtaposition is slightly greater than the height of the frontal triangle. Frons with a deep groove which terminates as a rhomboidal depression. Occipital triangle black, with projecting, elongate, black hairs. Antennae small, dull-black with whitish bloom; third antennal joint oval in outline, relatively large; its length is somewhat greater than the combined length of the 2 basal joints. Arista elongate, 1.5 times the length of the antenna, dark brown, almost black in color, somewhat furry. Scutum and scutellum glossy black, with elongate, black, projecting hairs, which are longest along the posterior edge of the scutellum; among these latter are several especially large, setiform hairs. Rest of thorax black, glossy with long, projecting, black and yellow hairs. Limbs black, with a broad band of yellow at both ends of the femora of all pairs. Wings with a brownish cast, which is particularly intense along the front margin and at the apex. Squammae light gray with a brown edge and colored hairs; halteres light brown, darker at the base and tip. Abdomen relatively long and narrow; black, faintly glossy with black and yellow semierect hairs dorsally and long, projecting light yellow hairs at the side of the tergites. Abdomen yellowish-brown ventrally, translucent, with long or relatively short hairs. Hypopygium small, dark brown with elongate, projecting light yellow hairs; gonopodial cerci chestnut brown and of irregular leaf-like form covered with rust-colored hairs; gonopodial coxite irregularly oval-shaped, narrowing somewhat towards its apex, with a faint lateral ridge, the whole structure covered with short, rust-colored hairs. (Fig. 1, B).

Body length 8 mm.

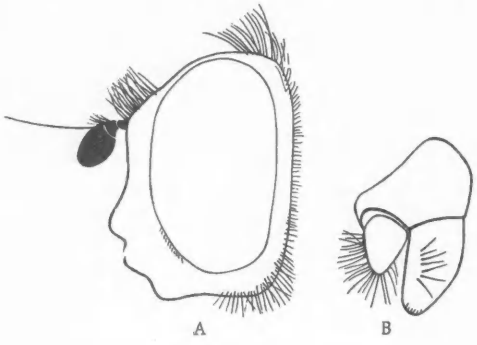

Fig. 1. Cheilosia tshyl, sp. n. A) Lateral view of head of male in profile; B) gonopodial cerci and gonopodial coxa in lateral view.

Female. Frons on the same level as the base of the antennae and approximately one third the width of the head, narrowing somewhat towards the vertex; frons black, glossy and covered with black hairs (mixed with some yellow ones) which are shorter and more delicate than those of the male. A transverse groove extends across the middle of the frons. Antennae dull black, with whitish bloom; third antennal segment broadly oval, large, being 1½ times as long as the two basal segments together. Arista dark brown in color, distinctly furry, elongate. Scutum and scutellum glossy, black, rather sparsely covered with short, semierect black and rust-colored hairs; along the posterior margin of the scutellum there are 12 black, bristle-like hairs, of which the middle 2 are considerably longer and stouter than the rest. Body of thorax black, glossy and covered with short, semi-erect, rust-colored hairs. Limbs, wings and abdomen as in male. Squammae and halteres bright yellow.

Body length of female 7 mm.

The description is based on 2 specimens (male, holotype; female, allotype) collected on the 8th and 10th of July, 1957 in the vicinity of the town of South Sakhalinsk, on a spur of the Susunaiskii mountain range; the insects were captured on vegetation bordering a mountain stream.

SPHAEROPHORIA KAA, sp. n.

This species is closely allied to Sphaerophoria men-

thrastri L., but differs from the latter in having constricted yellow patches on the abdomen in the femora,being dark at the base,and in the structure of the hypopygium (Fig. 2, D).

Male. Eyes naked, the length along which the eyes are in juxtaposition is slightly less than the height of the frontal triangle. Frons and face yellow, glossy; frons covered with long, slender, light yellow hairs. In profile the face is seen to have a well-defined, median prominence and is sometimes chestnut brown ventrally. There is a narrow rim of black around the mouth. Triangle of vertex convex, glossy black with long, coarse, black, erect hairs. Antennae yellow ocher in color; third segment oval with its anterodorsal angle dull brown. Arista naked, dark brown, glossy and short; its length being slightly more than that of the second and third antennal segments together. Scutum olive-gray slightly glossy, with 2 broad, median, gray, powdery stripes, which narrow as they approach the base of the wings. Scutellum dull yellow-ocher in color, bearing long, slender, light yellow hairs; sometimes these are interspersed with coarser black hairs along the posterior margin of the scutellum. Body of thorax black with a metallic sheen, and covered with long, erect, golden-yellow hairs; there are 5 yellow patches situated as follows: 1 above the coxae of the anterior limbs, 1 in the posterior half of the mesopleuron, 1 in the dorsal portion of the sternopleuron, 1 in the dorsal portion of the pteropleuron,and the other on the pleurotergite. Limbs yellow, except that the dorsal surface of the tarsus and the base of the femur (particularly the ventral surface) is dark brown, almost black (though this is a variable characteristic). The greater part of the surface of the limbs is covered with black hairs which are very dense, erect and particularly long on the postero-ventral surfaces of the 2 anterior femora. Wings brownish, stigma dark brown, veins dark chestnut. Wings are distinctly longer than the abdomen and when folded they extend beyond the tip of the abdomen. Squammae yellow, halteres bright yellow. Abdomen long, narrow, somewhat broader proximally, bearing yellow patches laterally and very short light yellow hairs, which on the posterior half of the body are interspersed with black hairs; hairs become longer and projecting on the sides of the 2 front tergites. The anterior margin of the yellow patches on tergites 2-4 broadly convex, the posterior margin almost straight (Fig. 2, B); there is a small yellow, almost square patch on the first abdominal tergite which extends towards its anterolateral angle. The fifth tergite is yellow and bears a central black figure in the form of an anchor, together with 2 black rectangular patches in the anterolateral angles of the tergite (in some individuals the black color predominates and the anchor pattern tends to be obliterated). The posterior margins of the third and fourth tergites and the lateral margins of all the abdominal tergites have a narrow band of yellow ; the posterior margin of the fifth tergite is broadly yellow. The relatively large hypopygium is ocher-yellow, with barely noticeable, silvery white fuzz; gonopodial cerci yellow, with very short, erect, light yellow hairs; the massive gonopodial coxite (Fig. 2, D) is brown and tapers anteriorily and internally; it is covered with very dense, long, golden-yellow hairs which are curved at the tip.

Length of body 8-11 mm.

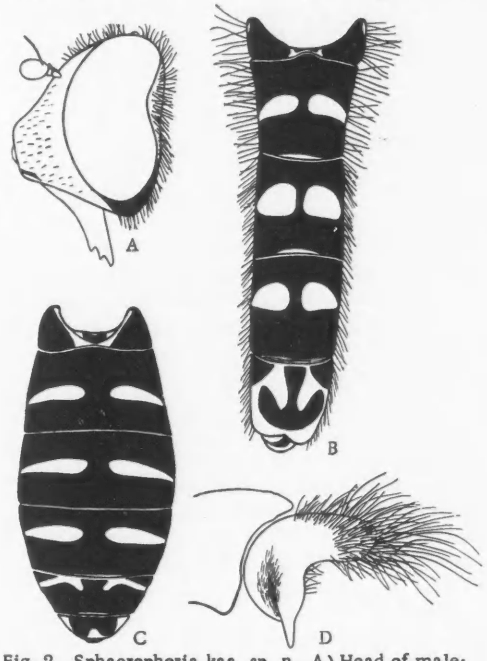

Fig. 2. Sphaerophoria kaa, sp. n. A) Head of male; B) abdomen of male from above; C) abdomen of female from above; D) gonopodial coxite of male, viewed from below, laterally.

Female. Width of frons at the base of the antennae is rather less than 1-third the total width of the head. Frons light yellow in color, smooth, glossy, with a few, delicate, colored hairs and with a shining black rectangle in the middle. Face bright yellow, glossy, covered with barely noticeable, scanty, short, erect, bright yellow hairs; there is a narrow border to the mouth. In profile the face is somewhat elongate anteriorly, the facial prominence is less well marked than in the male (Fig. 2, A). Antennae as in the male.

Vertex glossy black, with coarse, erect, black hairs; its width is 1-fifth that of the head as a whole. Scutum and scutellum as in male, except that the fuzz on them is shorter and light colored, and the scutellum in the female is completely covered with black hairs. The fuzz on the body of the thorax is less strongly developed than in the male; the yellow patches on the thorax are larger and more distinct in the female. Limbs bright yellow, with short, contiguous, mainly black hairs; the tarsi of all the limbs and the tibiae of the posterior pair chestnut brown. Wings transparent and slightly brownish; stigma brown; veins black; wings longer than the abdomen. Abdomen black, wider and shorter than in the male with

interrupted yellow bands on segments 2-4, and a yellow rectangular patch at the side of the first tergite, this patch being smaller than that in the male; the patch of yellow on tergite 5 is of irregular shape (Fig. 2, C). On the posterior margins of tergites 2-5 there may be narrow bands of yellow and the lateral margins of all the abdominal segments have narrow bands of the same color.

Length of body 5-9 mm.

This description is based on specimens caught in the vicinity of Nizkoberezhnii lake (Sakhalin Island, Terpenia Peninsula). The material consists of 1 female caught August 27, 1956, Moneron Island; 27 males and 17 females, caught July 21-24, 1957 from the vicinity of Lake Nizkoberezhnii, Terpenia Peninsula. Sakhalin Island (among which is the holotype and allotype; 3 males caught August 12-14, 1957, from the vicinity of Lake Khalaktyrskii, Kamchatka Peninsula.

PARHELOPHILUS KURENTZOVI, sp. n.

This species is closely related to P. versicolor F., from which it differs in having a slightly narrower frons in the male, in having black hairs on the posterior part of the scutum, a yellow base to the femur in the anterior and middle pair of limbs, by its characteristic pattern on the abdomen, by the presence of black hairs on the abdominal tergites, by the smaller hairs of the abdomen and by the structure of the hypopygium.

Male. Width of frons at its narrowest place is approximately 1/7 that of the head as a whole. Frons and face covered with a dense, golden-yellow bloom, which is darker in color on the upper part of the frons, together with long, erect hairs, black in color and more densely packed on the frons, and yellow in color and more scanty on the face. Face is straight in profile without any median facial prominence: Its lower portion projects further forward than the frontal prominence. Antennae orange-yellow, third segment oval, just slightly longer than broad; arista dark brown, naked and thickened over the basal third of its length; length of arista somewhat greater than width of antenna. Scutum black, with black bloom and with 4 broad, longitudinal stripes of dark gray powdery bloom and a narrow, median line of gray bloom; anterior margin of scutum, except for the humoral prominences with dark gray bloom. Anterior third of the scutum covered with long, erect, golden-yellow hairs, which are interspersed with an insignificant number of black ones; the rest of the scutum bears erect black hairs of the same length. Scutellum orange-yellow, with long erect, black hairs, with which at the edges are mingled yellow hairs. Body of thorax with a dense gray bloom and elongate, slender, erect golden-yellow hairs. Coxae of all limbs black, with a dense gray bloom. Anterior and middle limbs completely yellow, with light yellow hairs, which are longer and more erect on the hinder surfaces of the femora; there is a dark-colored splash on the lower side of the femora near to their bases. The posterior limbs are yellow with light colored hairs; the middle of the inner (posterior) surface of the femora, their dorsal surfaces and the dorsal surfaces of the tibiae are, however, glossy black; on the ventral surface of the femora along its distal half there is a row of strongly developed black setae. The posterior tibiae have dark brown rings basally and on the distal third of their length; the posterior tarsi are covered with dense black hairs dorsally and therefore they appear blackish-brown.

Coxae of middle pair of limbs bear strongly developed black setae anteriorly. Wings transparent, with a punctate brown eye-spot; squammae and halteres light yellow. Abdomen dull black, with broad yellow bands and patches on tergites 2-4. The first abdominal tergite is completely covered with a yellowish-gray bloom; the second tergite bears 2 large, yellow patches which are roughly triangular in shape and occur anterolaterally; along the posterior edge of this same tergite is a strip of yellowish gray bloom, which does not reach the lateral margins of the tergite; the lateral yellow patches on the third tergite are triangular in shape and somewhat smaller than those on the second, although like the latter they are anterior in position; the strip of yellowish-gray bloom on the posterior edge of the third tergite is wider than that on the second; the yellow patches of the fourth tergite are covered with a golden-yellow bloom; the posterior edge of this same tergite is covered with golden-yellow bloom, occupying the posterior third of the structure. The whole of the abdomen is covered with short black and yellow hairs; the latter are for the most part distributed over the lateral yellow patches on the tergites; the lateral walls of the first 2 abdominal segments bear long, fluffy, yellow hairs. The 3 anterior, abdominal sternites are light yellow in color and possess a scanty covering of pale hairs; they also bear dark colored, median spots; the 4th sternite dark brown with a narrow yellow stripe along its posterior edge. Hypopygium large, light yellow, with yellow hairs. The gonopodial coxite (Fig. 3) is a large compound structure, its distal portion and apical third covered with stout yellow hairs, while in the middle of its ventral edge is a triangular process supporting a ridge of long, dark colored hairs on its inner side; the ventral lobe of the gonocoxite is irregularly oval, with a slightly acute apex and a drawn-out ventral, proximal angle. Gonocerci small, irregularly triangular, covered with yellow hairs.

Body length 9-11 mm.

Female. Frons broader than in male; its width at the level of the antennal bases is approximately 1/4 that of the whole head. Scutum with yellow hairs mixed with a few black ones, mainly in the posterior half; the longitudinal colored stripes of the scutellum narrower than in the male. The dark colored splashes at the base of the anterior and middle femora are fainter than in the male or absent altogether, and the darker rings on the posterior tibiae are narrower and lighter colored than in the male. The yellow lateral markings on the second abdominal tergite are large; the median bridge of black occupies approximately 1/7 of the total width

of the tergite. Abdominal tergites 3 and 4 each with a broad yellow transverse stripe, situated near to the anterior edge of the tergite in both cases; on the third tergite the stripe is distinctly interrupted in the middle.

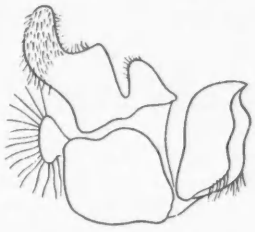

Fig. 3. Parhelophilus kurentzovi, sp. n. Gonopodial coxite and cerci of male in lateral view.

The bands along the posterior edges of tergites 2 to 4 are golden yellow. The fifth tergite is completely yellow with a dense golden-yellow bloom; it also possesses a longitudinal, glossy brown, median stripe, which extends as far as the middle of the tergite and dark, translucent areas, which show through the bloom, situated laterally in the posterior half of the tergite.

Body length 10-12 mm.

Localities. Sakhalin Island: Kholmsk, June 27, 1950 (2 females found on the slopes of a volcanic hill covered with mixed woodland, at an altitude of 600 m.); Southern Sakhalin, June 21 and 27, 1953 (2 females of which 1 is the holotype), July 12, 1950, June 16th and July 11, 1952, June 27, 1953 (4 females, including the allotype); Bykov, July 2, 1953 (1 female); Kuznetsova July 20, 1953 (2 females).

Kunashir Island: Near to Lake Lagunno, August 23rd 1953 (3 females on the flowers of Sakhalin buckwheat).

PARHELOPHILUS OBSCURIOR, sp. n.

This particular species is readily distinguished from all other paleoarctic members of the genus by the peculiar coloration of the abdomen, by the presence of gray bloom in the center of the yellow markings on the second and third tergites, by the glossy black trochanters of the limbs and by the structure of the hypopygium.

Male. Width of the frons at its narrowest point is approximately 1/8 the width of the head as a whole. Upper part of the frons and vertex brown with golden tinted bloom, lower part of frons and facial region with a dense golden-yellow bloom. Frons and vertex covered with long, erect black hairs; facial region with a more sparse covering of golden hairs. Nape with a dense ash-gray bloom and black hairs. Antennae orange-yellow; third antennal segment short (approximately as broad as long), rounded; arista elongate, 1.5 times as long as the antenna, dark yellow distally with a brighter yellow proximal half. Scutum dull black, with 4 moderately wide, elongate stripes of ash-gray bloom. Notopleura ash-gray with a gold tinted bloom. Scutum with a dense covering of long, erect black hairs which are intermixed with yellow hairs anteriorly. Body of thorax covered with a gray bloom, bearing also light yellow and black, long, delicate, erect hairs. Scutellum brownish-yellow, with blackish-brown lateral angles and covered with long black hairs which along its edges are mixed with yellow hairs. Coxae of all limbs dark brown, almost black, trochanters glossy black.

Anterior and middle pairs of limbs yellow; proximal half of anterior femora and proximal third of middle femora with glossy black on their posteroventral surfaces; fuzz on limbs yellow, with long, erect hairs on posterior surface of femora. The middle portion of the internal surfaces of the posterior femora and their upper surfaces, except for the proximal portion and narrow strip above the knee, are glossy black as though they had been polished; tibiae yellow, with 2 broad black rings, one proximal the other distal; tarsi dark brown. Wings slightly smoky; stigmata short, brown; r_{4+5} above the first postmarginal cell (R_5), rather feebly curved as compared with those of other members of the genus. Squammae pale yellow, with darker edges and yellow setae; halteres yellow. Abdomen black with yellow markings on the second and third tergites and patches or stripes of ash-gray bloom on all tergites. First tergite completely covered with ash-gray bloom; second and third tergite with relatively small (compared with other species of the genus), irregular light yellow lateral markings, occupying in the second tergite about 3/4 of its length, and in the third about half; yellow markings on second and third tergites occupy a median position, together with a rather large patch of gray bloom; in the anterior half of the fourth tergite there are rather large lateral patches of gray bloom which occasionally meet in the mid line. Abdomen with short black and yellow hairs; the light yellow markings on the second tergite are covered with long, slender light yellow hairs. The abdomen is light yellow ventrally with a large dark colored triangle at the base and small glossy black rectangular markings in the middle of the second and third sternites; the fourth sternite is dark brown with a narrow yellow posterior border.

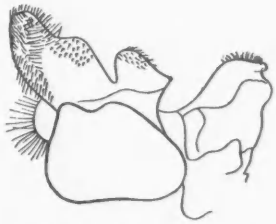

Fig. 4. Parhelophilus obscurior sp. n. Gonopodial coxites and gonocerci of male in lateral view.

Hypopygium large, with ash-gray bloom and colored hairs. In the structure of its hypopygium the species under

description more closely resembles P. kurentzovi, sp. n. than any other; it differs from the latter species in the following ways: its gonopodial coxites are of simpler structure (see Fig. 4); their distal parts are less sharply separated from the rest, the ventral angle is more acute and the covering of hairs on the distal part is not as dense. The gonocerci are moderately well developed; they are irregularly triangular in shape with truncate apices, yellow in color, with pale yellow hairs.

Length of body 8-9 mm.

Localities. Sakhalin Island: South Sakhalinsk, July 11, 1952 (2 males, 3 females, among which are the male holotype, and the female allotype).

The type specimens of the species described above are deposited in the collection of the Zoological Institute, Academy of Sciences of the USSR, in Leningrad.

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NEW DATA ON THE NASAL BOT FLY RHINOESTRUS TSCHERNYSHEVI GRUNIN (DIPTERA, OESTRIDAE) OF THE WILD SHEEP OVIS AMMON L.

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Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 1, pp. 210-212, January-March, 1960

Rhinoestrus tschernyshevi Gr. was first described in 1951, on the basis of a single third-instar larva, found by V. I. Chernyshev on June 12, 1949, in the nasal sinus of a wild sheep from the Kulyak Mountain district (Tadzhikistan SSR). Later 3 third-instar larvae of this species were discovered by A. A. Sludskii, L.I. Sokolov and E. F. Savinov on May 31, 1956, in the nasal sinus of an adult female wild sheep from the south-eastern Bet-Pak-Dala desert (Dzhambul mountains). More recently still, a single, dead, third-instar larva was found by K. Ya. Grunin on June 28, 1957, in the nasal sinus of a two-year-old wild sheep from the western part of the Tarbagastai mountain range (Semipalatinskii region, Kazakh stan SSR). Just before this last date (May 29, 1957), one of us (A. A. Sludskii) had found 10 third-instar larvae of Rh. tschernyshevi Gr. in the nasal sinuses of an adult female wild sheep from the Dzhambul mountains. An attempt was made to induce these larvae to pupate; this was successful and subsequently adult flies were obtained. All the larvae were placed on dry sandy soil containing a considerable amount of rubble. On the following day the 5 largest and most completely developed larvae pupated, whereas the rest died within a few days without burying themselves in the soil. From the pupae obtained in this way, 3 flies emerged on June 20 and 21, 1957; they proved to be normally developed females and form the material basis of the following description.

RHINOESTRUS TSCHERNYSHEVI, Gr.

Female (Fig. 1). Width of scutum in relation to body length is 1:2.6. Body length 10.5 mm. Width of head is slightly greater than that of scutum. The whole body surface appears naked, but under reasonable magnification a few hairs are visible on the scutum and on the abdominal tergites; these hairs are dark colored basally and golden-yellow distally. The hairs occur singly on tubercles, which are much smaller than those present on the scutum of Oestrus ovis L.

Frons is 1/2 width of head as a whole (Fig. 2); eyes relatively large, height being 1/2 that of the head as a whole. Ocelli glossy black, large; they are raised above the surface of the ocular triangle by an amount which is greater than half their diameter; ocelli fused. The upper halves of the orbits are furnished with many very small black tubercles which are many times smaller than the ocelli. Even smaller tubercles occur in rows on the posterior part of the head in a direction oblique to the lateral margin of the compound eyes. In the center of the upper half of the posterior wall of the head there is no glossy black plate such as occurs in Rh. purpureus

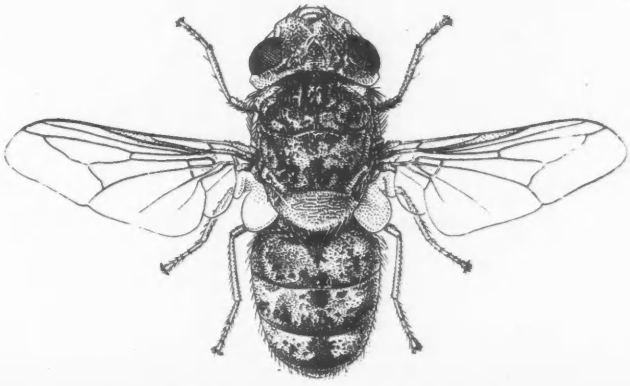

Fig. 1. Rhinoestrus tschernyshevi Gr. female.

Br. The orbits, genae and clypeus are brownish-yellow, waxy, and in places, translucent. A very characteristic feature of this species is the presence of a clearly defined, longitudinal ridge in the lower half of each

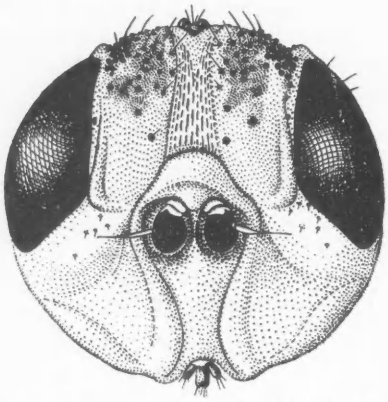

Fig. 2. Rhinoestrus tshernyshevi Gr., Head of female.

orbit. There are a few barely discernible hairs on the genae. Antennae rather large, about 1/5 the length of the clypeus. Third antennal segment is approximately twice as long as the first two together; it is curved, and as long as it is broad. The first and second antennal segments and the arista are yellowish; the third antennal segment is velvety black. The facial ridge is no longer than the antenna and is deeply saddle-shaped in the middle, consequently it is distinguished with difficulty. Clypeus is constricted in the middle, such that its width at the narrowest point is half that at the level of the antennae.

Mouth parts atrophied, light brown in color, consisting of small palps and a vestigial proboscis.

Across the middle of the scutum extends a transverse suture; the part lying to the front of this suture is only slightly shorter than that lying to its rear. Mesonotum black, dull, with a whitish-gray bloom or fuzz. The scutellum and the epimera as well are both brownish. Scutellum curved, subscutum convex, approximately six times as broad as it is high. In front of the suture across the mesonotum there are barely discernible longitudinal stripes, represented by areas devoid of hairs but covered with a light gray bloom. The ventral surface of the thorax is dull black.

Wings transparent and lacking the 3 shining black spots situated at the apices of a triangle near the wing base. Wing venation is that typical of the genus as a whole, vein rm lies markedly to the outside of the apex of sc. Squamae large, grayish-white in color with very short setules on their margins.

Limbs short; tibiae of all limbs shorter than the femora. Femora stout, basal 2-thirds black; basal part of femora, tibiae and tarsi light brown. Claws shorter than last segment of tarsus, black distally. Pulvilli very small.

Abdomen oval, equal in length to the thorax, strongly convex, without tubercles. Tergite VI triangular, equal in length to tergite V. Abdomen with a grayish iridescent bloom, black except for a feebly expressed longitudinal line on the posterior margin of the tergites.

Larva of the 3d stage. Armature on dorsal surface and at posterior border of the VIIth abdominal segment absent. On ventral surface lateral spines of all rows in the bands of the anterior border of segments do not differ from other spines; middle-lateral spines absent.

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TWO NEW HOSTS OF THE WARBLE-FLY OESTROMYIA LEPORINA PALL. (DIPTERA, HYPODERMATIDAE)

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Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 1, p. 213, January-March, 1960

A study of the rodents of a territory situated 10—15 km south-east of Anzhero-Sudzhensk (Kemerov Region), carried out from 1956 to 1959, revealed specimens of Microtis oeconomus Pall. and M. gregalis Pall. infested with larvae of Oestromyia leporina Pall.* Both species of meadow mice are recorded for the first time anywhere among the hosts of warble-flies, while the presence of O. leporina Pall. in the Kemerov Region has not been known hitherto.

The district investigated lies at an elevation of 200—300 m and consists of a hilly locality transsected by numerous deep river valleys. This territory includes mixed forest, aspen groves, hay fields situated between mixed forests and aspens, and arable land. Both of the species of meadow mice mentioned live primarily in hay fields among aspen groves, in aspen groves, and on arable land.

The larvae of the warble-flies (or the connective tissue capsules remaining under the skin after the larvae have dropped off) were found in young and adult meadow mice of both sexes, in July only.

Among 16 specimens of M. oeconomus collected in July, warble-fly larvae were found in two specimens (July 28, 1956 and July 23, 1959); empty capsules were likewise found in two specimens (July 11 and 14, 1957). Of these four infested specimens two were caught in an aspen grove.

Among 53 specimens of M. gregalis collected in July warble-fly larvae were found in six (July 24—28, 1956) and empty capsules were found in three specimens (July 24-27, 1956). Of these infested individuals, seven were caught in an aspen grove.

In most instances the larvae were localized in the posterior half of the body of the host, usually at the sides, rarely in the inguinal region; one larva was found in the anterior half of the body on the lower surface. The larvae were found in numbers of one (three host specimens) or two (five host specimens) individuals per meadow mouse, however, two M. oeconomus were found with five or six empty connective tissue capsules.

SUMMARY

In the vicinity of Anzhero-Sudzhensk (Kemerov Region) Microtus oeconomus Pall. and M. gregalis Pall. have been recorded as hosts of Oestromyia leporina Pall. for the first time.

*Determination by K. Ya. Grunin, Zoological Institute, AN SSSR.

A REVISION OF THE TRIBE PETROBIINI (REKK) (ACARIFORMES, TETRANYCHIDAE)

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pp. 214-226, January-March, 1960

Systematic study of the spider-mite family (Tetranychidae Donnadieu, 1875) cannot yet be considered concluded. In 1950 G. F. Rekk divided the family into three subfamilies: Bryobinae, Tetranychinae, and Eurytetranychinae, but in 1952 he went further and split the family into two. Rekk's classification has not been widely accepted, however. As may be seen from the table, there is no common opinion on the treatment of the spider-mite family; this is explained primarily by the fact that the relationships between genera have not been sufficiently studied, that is, the immediate suprageneric categories — the tribes — have not been established accurately enough. The least studied tribe is the Petrobiini. Womersley [1940] recognized the following genera belonging to the Petrobiini (in 1940 the Tetranychidae were not divided into tribes): Petrobia Murray, 1877, Tetranobia Banks, 1917, and three newly established monotypic genera — Tenuicrus, Schizonobia, and Aplonobia. MacGregor [1950] correctly considered Tetranobia a synonym of Petrobia and included two additional genera in this group — Tetranychina Banks, 1917, and the monotypic Monoceronychus McGregor, 1945. G. F. Rekk [1950] recognized three genera — Petrobia, Tetranychina, and Mesotetranychus Rekk, 1948. In their revision Pritchard and Baker [1955] first established the tribe Petrobiini (Rekk) with the genus Petrobia, in which they included Tetranychina, Mesotetranychus, Schizonobia, Aplonobia, and Monoceronychus. They considered Tenuicrus a synonym of Petrobia. The author (Vainshtein [1956]), before acquaintance with the above-mentioned revision, described two monotypic genera close to Monoceronychus — Mesobryobia and Neopetrobia.

Classification of the Family of Spider-Mites

Author	Families	Subfamilies	Tribes
Rekk (1952)	Bryobiidae.	Bryobiinae Rekk	–
		Petrobiinae Rekk	–
	Tetranychidae	Tetranychinae Rekk	–
		Eurytetranychinae Rekk	–
Pritchard and Baker (1955)	Tetranychidae	Bryobiinae Berl.	Bryobiini (Rekk)
			Hystrichonychini Pr. et. Bak.
			Petrobiini (Rekk)
		Tetranychinae Berl.	Tenuipalpoidini Pr. et. Bak.
			Eurytetranychini (Rekk)
			Tetranychini (Rekk)
Vainshtein (1958)	Tetranychidae	Bryobiinae Berl.	Bryobiini (Rekk)
			Hystrichonychini Pr. et. Bak.
			Petrobiini (Rekk)
		Tetranychinae Berl.	Tenuipalpoidini Pr. et. Bak.
			Tetranychini (Rekk)
		Eurytetranychinae Rekk	Eurytetranychini

Later R. E. Beer and D. S. Lang [1957] described the monotypic genus Schizonobiella. Thus, the number of genera belonging to the tribe Petrobiini is now 10 (of 12 14 genera in the subfamily) and the number of species included exceeds 30, thus presenting us with the opportunity to examine the classification of this tribe once again.

Eleven species were directly examined: Petrobia latens Müller, P. brevipes Rekk et Bagd., P. shirakensis Rekk, Neopetrobia dubinini Vainsht., Mesotetranychus vachustii Rekk, M. samgoriensis Rekk, Tetranychina spectabilis Rekk (=T. harti Ewing), T. zachvatkini Rekk et Bagd., Mesobryobia cervus Vainsht., Aplonobia (Paraplonobia) echinopsili, sp. n., Monoceronychus (Mesobryobia) ter-poghosiani (Bagd., 1959). The remaining species were studied from descriptions and figures.

The work is based on a study of the following characters.

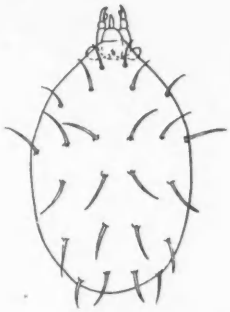

Fig. 1. Schizonobia sycophanta Womers.

Dorsal bristles. The shape of these may be fusiform, foliaceous, spatular, or aciculate. In the first three cases they are short, fringed, and their length does not exceed the distance between the rows of bristles. In the latter case they are large, fringed or serrate, and their length exceeds the distance between the rows of bristles. The shape of the bristles on a single mite may vary; for instance, the anterior may be foliaceous and the posterior fusiform.

Location of dorsal bristles. The surface of the dorsum may in some cases form tubercles on which the bristles are arranged; tubercles may be situated under all the bristles, only under the posterior dorsal ones, or be altogether absent. The inner sacral bristles may be situated at the same distance from one another as the inner prelumbar and lumbar bristles, and be at the same distance from the latter as the prelumbar are from the lumbar; in this case we speak of their central location (Fig. 5); it may be, however, that the inner sacral bristles are far removed from the lumbar and from one another and moved closer to the lateral surfaces of the body; this position we call marginal (Figs. 3, 4, and 6).

The cuticular surfaces may be bare and sulcate, as in the true red-spiders (Tetranychus), or it may be coarsely folded, as in Bryobia, or finally it may form specialized tubercular structures (Reckia, gen. nov.).

Peritremes. Before talking about the variation of the peritremes, we will briefly describe their structure (after Blauvelt, 1945, with additions), since there is no such description in our literature. The peritremes are tubes with a longitudinal slit along their entire length. They lie in the integument of the cheliceral funnel in such a manner that the slit of the peritremes opens into the space of this funnel. The inner ends of the peritremes come together, merge, and enter the body cavity, bringing air to the tracheal system, of which the peritremes form a part. The outer ends of the peritremes enclose the stylophore and lie within the lateral walls of the cheliceral funnel. Here they may differ strongly in form; in some of the species they are represented by a curved tube of constant diameter, in others the apex of the peritreme is widened, while in a third group it is branched

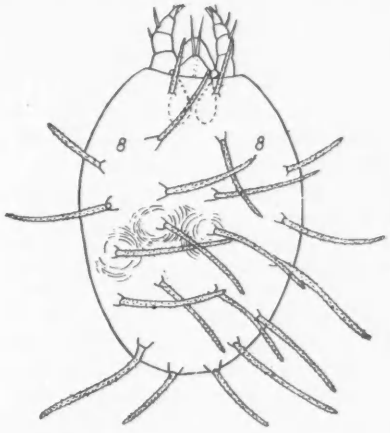

Fig.2 Tenuicrus errabundus Womers.

The branches of the peritreme may lie in the integument of the cheliceral funnel independently, or they may also secondarily merge with one another at some points or along their entire length, forming a complex design. In some cases a process forms at the end of a simple unbranched peritreme and penetrates into the cavity of the cheliceral funnel. The shape and dimensions of this process, called the enlargement of the peritreme, are of great diagnostic importance. True, Pritchard and Baker presumably showed that in some specimens of Bryobia praetiosa Koch — a species usually possessing a long peritremal enlargement — the enlargement is small, broadly rounded, and does not protrude from the cheliceral funnel when the stylophore is protracted. The authors drew the conclusion from this that not only the shape, but even the presence of the enlargement of the peritreme cannot serve as a diagnostic generic character. It is, however, impossible to concur with this; in the first place, it may be imagined that the authors named above were dealing with a group of species, and not with

one B. praetiosa, since the systematics of the genus Bryobia have not yet been sufficiently studied; in the second place, it is not possible to transfer automatically observations made on one group to another, even a closely related one; finally, in the third place, it is not possible to consider one character as "generic" and another as "specific", not taking into account the nature of the variation in this character. The same character may be constant in all the species of a genus while in the species of a related genus it may vary to different extents. As we will see below, the structure of the peritremes in the tribe Petrobiini provides excellent characters for the diagnosis of both species and genera.

Empodium. The predominant type of empodium is clawlike with two rows of chetoids. But in many species the claw has shortened and the empodium has become converted into a pad with two rows of chetoids. Two species have a shortened empodium with only one pair of chetoids and, finally, two species have a clawlike empodium also with but one pair of chetoids.

The last important character is the comparative length of the appendages.

An analysis of all the available species, and those described but unknown to the author in nature, revealed the following:

1) Of 33 true species of the tribe, 19 possessed a large, well-developed enlargement of the peritremes protruding far out of the cheliceral funnel; 12 species had no enlargement; 2 intermediate species, that is, those with a very small, poorly defined enlargement, were found.

2) Between the clawlike and the padlike empodia there are rare intermediates showing a padlike empodium which is feebly curved.

3) Several species possess bristles of differing types: fusiform and foliaceous, long and short, borne by tubercles or not, but there is a group of species in which the form of the bristles clearly correlates with other characters.

4) The arrangement of the inner sacral bristles is of only two types: central and marginal.

Attempting to group the species in such a manner that each group contains species which are identical in all of the above-mentioned characters, we find it necessary to create 14 such groups, comprising one to six species each. It then happens that the primary groups thus obtained display varying degrees of similarity to each other: Some differ by many characters and some by only one. By uniting the latter we obtain secondary groups of similar species, to which we ascribe the rank of genera, the primary groups of similar species being regarded as subgenera. The differences between species within the subgenera take the form of variations in the characters common to the subgenera. For instance, all the members of the genus Monoceronychus, s. str. are characterized by the presence of a median lobe of the frontal process, but in each species this process has a different form; the presence of an enlargement of the peritreme is characteristic of the entire subgenus Petrobia s. str., but the form of this enlargment is different in each species, and so forth. In accordance with the preceding we accept the following genera.

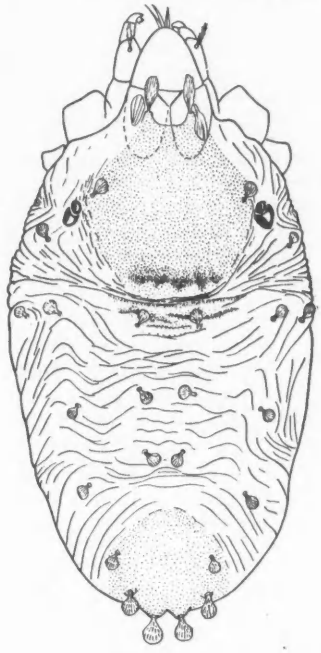

Fig. 3. Monoceronychus (Mesobryobia) ter-poghossiani (Bagd.).

GENUS PETROBIA MURRAY, 1877

Tetranobia Banks, 1917; Tetranychina Banks, 1917; Neobryobia Rekk, 1948; Mesotetranycnus Rekk, 1948.

Type — Acarus latens Müller, 1776.

The only genus comprising forms both with and without an enlargement of the peritremes. Empodium clawlike, with two rows of chetoids. Dorsal bristles short and fusiform or long and aciculate. In the former case the tubercles are absent or weakly developed on the posterior part of the body, in the latter case the bristles are situated on strongly developed tubercles. Integument with fine grooves. Anterior legs shorter than body or longer. Ubiquitous. Three subgenera.

SUBGENUS PETROBIA, S. STR.

Englargement of peritremes always well developed; "solenidia" present on all tarsi and on first tibia.

SUBGENUS TETRANYCHINA (Banks, 1917).

Type — Tetranychina apicalies Banks, 1917.

Enlargement of peritreme absent or very small; "solenidia" present on all tarsi and on first tibia.

SUBGENUS MESOTETRANYCHUS (Rekk, 1948).

Type — Mesotetranychus vachustii Rekk 1948.

Enlargement of peritremes very small rudimentary; "solenidea" absent on third and fourth tarsi and on first tibia; legs short.

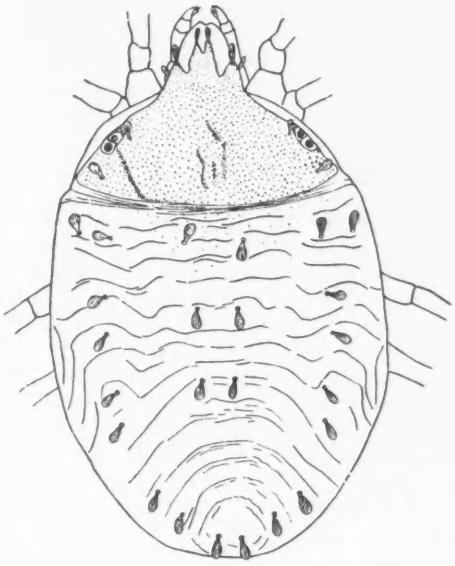

Fig. 4. Bryobia redikorzevi.

GENUS GEORGIOBIA VAINSHTEIN, GEN. NOV.

Type — Petrobia shirakensis Rekk, 1955.

Enlargement of peritremes well developed. Empodium padlike with two rows of chetoids. Sacral bristles central. Dorsal bristles long, aciculate, set on strong tubercles. Integument with coarse plica and fine striae. Unlike all the other genera of the tribe the median humeral bristles are not situated in one transverse (usually curved) row with the inner and outer humerals, but are displaced laterally and situated in one longitudinal row with the outer humeral and outer lumbar bristles. Found in the Transcaucasus.

GENUS SCHIZONOBIA WOMERSLY, 1940

Type and unique species — Schizonobia sycophanta Womersley, 1940.

Enlargement of peritremes very strong, globular. It is evident from Fig. 1 (Fig. 9a of Womersley) that the peritremes of Schizonobia have enlargements which distinctly project from the cheliceral funnel. Dorsal bristles of moderate length, the caudal pair absent. No tubercles. First and second coxae with three bristles each. Empodium clawlike, with one pair of chetoids. Thus, the genus is unique in the family in the number of coxal setae, and in the absence of caudal setae it is similar only to the equivocal Tenuicrus. Found in Australia.

GENUS APLONOBIA WOMERSLEY, 1940.

Type — Aplonobia histricina (Berlese, 1910) (= Tetranychopsis histricina Berlese, 1910; Aplonobia oxalis Womersely, 1940).

Peritremes branched in varying degree, without enlargement, dorsal setae long and set on tubercles or short and fusiform and without tubercles. Inner sacrals situated centrally. Empodium padlike with two rows or with one pair of chetoids. Legs always shorter than body.

SUBGENUS APLONOBIA, S. STR.

Peritremes strongly branched. Dorsal bristles, or at least some of them, set on tubercles. Bristles tc absent on first tarsi. Empodium padlike with two rows of chetoids. Found in Australia and America.

SUBGENUS PARAPLONOBIA VAINSHTEIN SUBGEN. N.

Type — Aplonobia (Paraplonobia) echinopsili Vainsht. (in litt.).

Related to the preceding subgenus, from which it differs in the unbranched peritremes, the short dorsal bristles, set on tubercles or not, and the presence of bristles tc on the first tarsus. Found in America, in the Transcaucasus, and Central Asia.

SUBGENUS ANAPLONOBIA VAINSHTEIN, SUBGEN. N.

Type — Aplonobia calame Pritch. and Bak. 1955.

Characterized by the shortened padlike empodia bearing only one pair of chetoids, the short dorsal bristles set without tubercles or on very minute ones, and the strongly branched, complex peritremes. Found in America.

GENUS MONOCERONYCHUS McGREGOR, 1945

Type — Monoceronychus californicus McGregor, 1945.

We are here including Mesobryobia Vainsht., 1956, as a subgenus.

Enlargement of peritremes well developed, cylindrical or conical. Dorsal bristles foliaceous or partly foliaceous and partly fusiform, set on small tubercles which are usually present only on the hind body, more rarely under all bristles. Distribution of median sacral bristles marginal. Integumentary folds usually coarse. Empodium padlike. A frontal process present on propodosoma.

SUBGENUS MONOCERONYCHUS, S. STR.

With a median lobe on frontal process. Found in America. On various monocotyledons.

SUBGENUS MESOBRYOBIA (Vainsht., 1956).

Type — Mesobryobia cervus Vainshtein, 1956.

Median lobe of frontal process absent. Found in America, Armenia, and Southern Kazakhstan. On grains.

GENUS NEOPETROBIA VAINSHTEIN, 1956.

Type — Neopetrobia dubinini Vainshtein, 1956.

The presence of an enlargement of the peritremes, padlike empodia with two rows of chetoids, and the

marginal location of the inner sacral bristles relate this genus to the preceding, from which it differs in the fusiform dorsal bristles and the absence of a frontal process. Found in Kazakhstan, Armenia, and America.

GENUS RECKIA VAINSHTEIN, GEN. NOV.

Type and unique species — Mesotetranychus samgoriensis Rekk, 1949.

An inaccuracy crept into the description of the only known species: The ends of the peritremes are not "broadened" here but rather crowned by a small elongate-oval expansion. This inaccuracy led A. T. Bagdasaryan erroneously to indicate that in the genus Mesotetranychus the enlargement is absent, without making an exception for M. samgoriensis.

The presence of an enlargement of the peritreme, the padlike empodia bearing two rows of chetoids, the dense dorsal bristles, and the lateral position of the inner sacral bristles relate Reckia to Monoceronychus; however, the tubercular nature of the dorsal body surface of the former genus makes it impossible to unite it with the other. There is even less basis for relating this genus with Mesotetranychus, with which Reckia shares only one common character — short appendages. The bristles are short, fusiform, strongly fringed; the sacrals and caudals are set on strong tubercles, the rest on tubercles which do not stand out from the tubercularity of the integument, which makes it difficult to consider them present. Found in the Transcaucasus.

GENUS SCHIZONOBIELLA BEER and LANG, 1957.

Type and unique species — Schizonobiella aeola B. and L., 1957.

Peritremes forming a rounded enlargement. Empodium clawlike, with one pair of chetoids. Bristles longer than distance between their rows, set on tubercles. A characteristic feature of this genus is the presence in the female of only one pair of duplex chetae on the first tarsi, and in the male of three or four pairs on the first tarsi and six to eight on the first tibiae, whereas in all known Bryobiinae the duplex chetae on the first tarsi are present as two pairs in both sexes and are always absent on the tibiae. Found in North America.

GENUS TENUICRUS WOMERSLEY, 1940.

Type and unique species — Tenuicrus errabundus Womers., 1940.

Pritchard and Baker believe that T. errabundus is a synonym of T. harti. Actually, these species are very similar in habitus. However, several characters, if they were correctly indicated by Womersley, compel us to adopt the genus proposed by him even though its position in the classification is not clear. The characters which relate T. errabundus to T. harti are the following: the presence of a clawlike empodium with two rows of chetoids, strong dorsal bristles set on tubercles, and very long anterior appendages. Additional characters are the small, rounded enlargement of the peritremes, the presence of only one pair of bristles on each coxa, whereas in all other Tetranychidae their numbers are as follows: 2—2—1—1 except for Bryobia: 2—1—1—1 and Schizonobia: 3—3—1—1), and, finally, the usual number of dorsal bristles: 2—4—4—4—4—4. In the latter case an error is evident: the outer humeral bristles are not mentioned but, in addition, one more pair is missing. If this is really the case, then the uniqueness of the genus is not doubted; if rather the bristles were simply not mentioned by the author, it is probable that one of the marginal pairs was omitted and not the central ones figured by the author in Fig. 8-A (our Fig. 2); in this case the type of chaetotaxy in Tenuicrus is not tetranychoid but bryobioid and the genus still cannot be united with any of those described above.

The changes adopted in the classification have the following consequences. The genus Tenuicrus, erroneously relegated to the synonymy by authors, is re-established. The genus Tetranychina is separated from Petrobia but is included in the latter at the subgeneric level, since these genera posess different peritreme structures; two species — T. richteri and T. zachvatkini, posessing an enlargement of the peritreme and comparatively short appendages, are withdrawn from this subgenus, T. zachvatkini being transferred to the subgenus Petrobia s. str. and T. richteri, with padlike empodia, to the new genus Georgiobia.

Mesotetranychus proved to be heterogeneous. The type of the genus — M. vachustii — is placed in the genus Petrobia, being related to the latter by the structure of the empodium and peritremes and the distribution of the dorsal bristles, and is preserved as a separate subgenus; M. hermariae, posessing padlike empodia, is transferred to the genus Aplonobia; M. samgoriensis, characterized by a series of original features, is separated into a new independent genus Reckia, which we place near Monoceronychus.

In the new genus Georgiobia, P. shirakensis, P. sisianesis, and T. richteri are united by an original combination of characters — peritremes with enlargement, as in Petrobia s. str., empodium padlike as in Aplonobia and very long bristles on strong tubercles as in Tetranychina, and a distribution of humeral bristles which is unusual for the tribe.

The genus Mesobryobia is introduced into the subgenus Monoceronychus, which includes M. corynetes from the typical subgenus and P. ter-poghosiani Bagd. Monoceronychus mcgregori Pritch. and Bak. is transferred to the genus Neopetrobia.

Finally the genus Aplonobia is broken up into subgenera.

At first glance the classification arrived at seems unduly fragmented. However, analysis shows that this "fragmentation" follows completely naturally from the nature of the character variability in this group. There can be only one way of avoiding this and that is by

uniting two or three genera into one, thus following the idea that some characters (such as the structure of the empodium) are purely "generic" and others (such as the structure of the peritremes) are only "specific". We cannot go along with this but ascribe to each character, or more correctly to each system of characters, an equal significance — they are specific in detail, generic in general aspect. Thus we proceed from the assumption that characters are in themselves hierarchical, for instance, the presence or absence of peritremes is a familial or superfamilial character, the presence or absence of an enlargement of the peritreme is a generic and tribal character, and the structural details of this enlargement are specific characters; the presence of an empodium with chetoids is a familial and superfamilial character, the presence or absence of the clawlike part of the empodium is a generic character, and the form of this claw and the dimension of the empodium are specific and subgeneric characters, and so forth. For this reason any system which is based on an excessive magnification of the importance of some characters and diminution of the importance of others could not correspond to the natural classification of the organisms. All organs are of equal importance to an organism, consequently the structure of all organs (characters) must be taken into consideration to an equal extent.

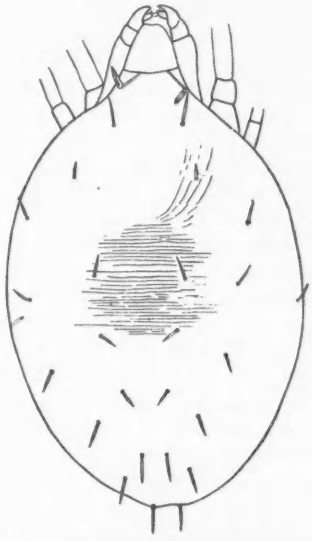

Fig. 5. Petrobia latens Müll.

On examination of the species of Monoceronychus (Fig. 3) it is easy to see that these are much more similar to Bryobia (Fig. 4) in habitus than to typical Petrobiini (Fig. 5). They are close to the former in the presence of a frontal process (absent in the Petrobiini), foliaceous bristles (absent in the Petrobiini), and in the marginal distribution of the sacral bristles. Unlike Bryobia and like other Petrobiini, Monoceronychus posesses short pad-like ambulacra while the number of dorsal bristles (including the anal) is 36, while in the Bryobiini it is 42.

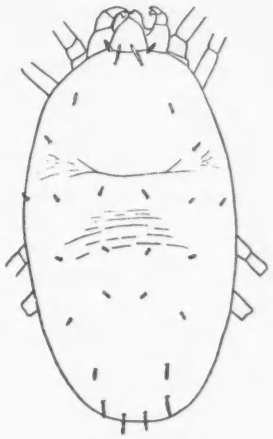

Fig. 6. Neopetrobia dubinini Vainsht.

Thus this genus posesses characters which are intermediate between the Bryobiini and Petrobiini, which gives us the right to separate it into an independent tribe Monoceronychini. In this same tribe we are including the genera Neopetrobia and Reckia, which possess short, fusiform or thickened dorsal bristles distributed in a "bryobioid" manner, that is, with the sacral bristles moved apart.

The tribe Monoceronychini occupies a position which is intermediate between the Bryobiini and Petrobiini, while the genus Neopetrobia (Fig. 6) shows a transition from Bryobia through Monoceronychus towards Petrobia in the form of the dorsal chaetotaxy.

Thus, the classification we have proposed for the subfamily Bryobiinae has the following form.

Tribe Bryobiini (Rekk), genera:

1. Bryobia Koch, 1836, with the subgenus Pseudobryobia (McGregor, 1950);
2. Tetranycopsis Canestrini, 1889.

Tribe Hystrichonychini Pr. and Bak., genus:

3. Hystrichonychus McGregor, 1950.

Tribe Monoceronychini Vainshtein, tribus novus, genera:

4. Monoceronychus McGregor, 1945, with subgenus Mesobryobia (Vainshtein, 1956).
5. Neopetrobia Vainshtein, 1956;
6. Reckia Vainshtein, gen. nov.

Tribe Petrobiini (Rekk), genera:

7. Petrobia Murray, 1887, with subgenera Tetranychina (Banks, 1917) and Mesotetranychus (Rekk, 1948);

8. Aplonobia Womersley, 1940, with subgenera Paraphonobia Vainshtein, subgen. nov., and Anaplonobia Vainshtein, subgen. nov.;

9. Schizonobia Womersley, 1940;

10. Tenuicrus Womersley, 1940;

11. Schizonobiella Beer and Lang, 1957;

12. Georgiobia Vainshtein, gen. nov.

KEYS TO THE TRIBES AND GENERA OF THE SUBFAMILY BRYOBIINAE

1 (6). Two pairs of vertical bristles. (Tribe Bryobiini).

2 (5). Dorsal bristles thickened. Ambulacra II—IV always, and I primarily, clawlike. . . . . Bryobia, s. l.

3 (4). Enlargement of peritreme present. . . . . Bryobia, s. str.

4 (3). Enlargement of peritreme absent. . . . . Pseudobryobia.

5 (2). Dorsal bristles aciculate, stout. All ambulacra padlike. . . Tetranycopsis.

6 (1). One pair of vertical bristles.

7 (8). Three pairs each of prelumbar and lumbar bristles. (Tribe Hystrichonychini). Unique genus. . . . . Hystrichonychus.

8 (7). Two pairs each of prelumbar and lumbar bristles.

9 (14). Inner sacral bristles located close to outer ones. (Tribe Monoceronychini).

10 (11). Frontal process present. All or some of dorsal bristles foliaceous or lanceolate; in latter case, some bristles aciculate . . . . . Monoceronychus.

11 (10). Frontal process absent. All dorsal bristles fusiform or some of them lanceolate.

12 (13). Integument with the usual striations. All dorsal bristles fusiform. . . . . Neopetrobia.

13 (12). Integument with numerous tubercles. Some dorsal bristles thickened. . . . . Reckia.

14 (9). Inner sacral bristles centrally located. (Tribe Petrobiini).

15 (20). Empodium clawlike.

16 (17). Empodium with two long rows of chetoids. Peritremes with or without enlargement, if present it is long or rudimentary. . . . . Petrobia.

17 (16). No caudal bristles. Three bristles each on coxae I and II. The usual number of chaetopariae on legs. . . . . Schizonobia.

18 (19). No caudal bristles. Three bristles each on coxae I and II. The usual number of chaetopariae on legs. . . . . Schizonobia.

19 (18). Caudal bristles present. Two bristles each on coxae I and II. One pair of duplex setae on tarsus I in the female, 3—4 pairs in the male. 6—8 chaetopariae on tibiae. . . . Schizonobiella.

20 (15). Empodium padlike.

21 (22). Enlargement of peritremes strong. Median humeral bristles located in one longitudinal row together with outer humeral and inner prelumbar bristles. . . . . Georgiobia.

22 (21). Enlargement of peritremes absent. Median humeral bristles located in one transverse row together with outer and inner humerals. . . . . Aplonobia.

The key does not include the genus Tenuicrus, the position of which is not certain.

KEY TO THE SUBGENERA AND SPECIES OF THE TRIBE MONOCERONYCHINI

Genus Monoceronychus McGregor

1 (12). Median lobe of frontal process present. (Subgenus Monoceronychus, s. str.).

2 (5). All dorsal bristles foliaceous or lanceolate.

3 (4). All dorsal bristles oval-lanceolate with rounded apices. . . . californicus McGregor, 1945.

4 (3). Dorsal bristles elongate-oval, sacrals and caudals broadly lanceolate, pointed. . . . . aechmetes Pr. and Bak., 1955.

5 (2). Some dorsal bristles fusiform or spiniform.

6 (7). All marginal dorsal bristles stout and aciculate, spiniform. . scolus Pr. and Bak., 1955.

7 (6). Some marginal bristles lanceolate or foliaceous.

8 (9). Both pairs of sacral bristles lanceolate. . . . . linki Pr. and Bak., 1955.

9 (8). Outer sacral bristles elongate-fusiform.

10 (11). Median lobe of frontal process broad, rounded; lateral lobes very small, barely perceptible. Anterior legs shorter than body. . . . . enoplus Pr. and Bak., 1955.

11 (10). Median lobe of frontal process narrow, acute, lateral lobes well developed. Anterior legs longer than body. . . . . machetes Pr. and Bak., 1955.

12 (1). Median lobe of frontal process absent. [Subgenus Mesobryobia (Vainshtein, 1956)].

13 (14). Caudal and outer sacral bristles narrowly lanceolate; a macrochaeta present on tibia IV. . . . . cervus Vainshtein, 1956.

14 (13). All dorsal bristles foliaceous. No macrochaeta on tibia IV, i.e., no bristles prominent in length.

15 (16). Frontal process very feebly developed. All dorsal bristles approximately equal in size elongate-oval and set on small tubercles. . . . . corynetes Pr. and Bak., 1955.

16 (15). Frontal process well developed. Outer sacral and caudal bristles stronger than others and set on strong tubercles. Form of bristles circular (= Petrobia terpoghossiani Bagd., 1954). . . . . ter-poghossiani (Bagd., 1954).

Genus Neopetrobia Vainsht.

1 (2). Tarsus I with 21 bristles including three "solenidia" and tc. . . . . dubinini Vainsht., 1956.

2 (1). Less than 20 bristles on tarsus I.
3 (4). Tarsus I with 11 bristles, including 2 "solenidia"; bristles tc absent . . (= Monoceronychus mcgregori Pr. and Bak., 1955). . . . . mcgregori Pr. and Bak., 1955.
4 (3). Tarsus I with 14 bristles . . (= Petrobia vediensis Bagd., 1959). . . . . vediensis (Bagd., 1959).

KEYS TO THE SUBGENERA AND SPECIES OF THE TRIBE PETROBIINI

Genus Petrobia Murray

1 (6). Enlargement of peritremes well developed; "solenidia" present on tarsi III and IV and tibia I. (Subgenus Petrobia, s. str.).
2 (5). Dorsal bristles fusiform, shorter than distance between rows, not set on tubercles or latter weak and only on hind body. Enlargement of peritremes cylindrical or conical with longitudinal markings.
3 (4). Tarsus I with 23 bristles, including three "solenidia" and tc. Leg I longer than body or slightly shorter . . . latens (Müller, 1776).
4 (3). Tarsus I with 18 bristles, including two "solenidia"; bristles tc absent. Legs I considerably shorter than body. . . . . brevipes Rekk and Bagd., 1949.
5 (2). Dorsal bristles aciculate, longer than distance between their rows, set on strong tubercles; enlargement of peritremes oval with a reticular surface (= Tetranychina zachvatkini Rekk and Bagd., 1949). . . . . zachvatkini (Rekk and Bagd., 1949).
6 (1). Enlargement of peritremes absent or very small. "Solenidia" on tarsi III and IV and tibia I present or absent.
7 (12). Anterior appendages not shorter than body; supplementary "solenidia" on tarsus I, "solenidia" on tarsi III and IV and tibia I present. [Subgenus Tetranychina (Banks, 1917)].
8 (11). Peritremes branched. Legs I as long as body in female, twice as long in male.
9 (10). Dorsal bristles, except sacrals considerably shorter than distance between their rows and set on tubercles. Peritremes strongly branched, their branches forming a lattice. . . . . apicalis Banks, 1917.
10 (9). All dorsal bristles longer than distance between their rows, set on strong tubercles. Peritremes apically curved and weakly branched. . . . . lupini McGregor, 1950.
11 (8). Peritremes not at all branched, sometimes apically feebly widened. Legs I twice as long as body in female, three times as long in male. . . . . harti (Ewing, 1909).
12 (7). Anterior appendages considerably shorter than body; supplementary "solenidia" on tarsus I, "solenidia" on tarsi III and IV and tibia I absent. [Subgenus Mesotetranychus (Rekk 1948)]. Unique species; (= Mesotetranychus vachustii Rekk, 1948). . . . . vachustii (Rekk, 1948).

Genus Georgiobia Vainshtein, gen. n.

1 (2). Anterior appendages twice as long as body (= Petrobia shirakensis Rekk, 1956). . . . . shirakensis (Rekk, 1956).
2 (1). Anterior appendages slightly longer than body.
3 (4). Dorsal bristles obtuse, the outer and median ones strongly approximated (= Tetranychina richteri Bagd., 1954). . . . richteri (Bagd., 1954).
4 (3). Dorsal bristles acute, the outer and median humerals not approximated (= Petrobia sisianensis Bagd., 1959). . . . sisianensis (Bagd., 1959).

Genus Aplonobia Womersley

1 (12). Empodium padlike, bearing 2 rows of chetoids.
2 (7). Peritremes strongly branched, their branches forming pattern. All dorsal bristles or some of them long, set on tubercles. (Subgenus Aplonobia, s. str.).
3 (6). All dorsal bristles not shorter than distance between their rows and set on strong bristles.
4 (5). Dorsal bristles equal in length to distance between their rows or somewhat longer. Empodium twice as long as ambulacra . . . . . histricina (Berlese, 1910).
5 (4). All dorsal bristles longer than distance between their rows. Empodium equal in length to ambulacra. . . . . deina Pr. and Bak., 1955.
6 (3). Caudal, sacral, and outer lumbar bristles longer, set on strong tubercles. Rest of dorsal bristles fusiform, considerably shorter than distance between their rows; tubercles beneath them barely differentiated. . . . . anisa Pr. and Bak., 1955.
7 (2). Peritremes not branched. All dorsal bristles short, not set on tubercles. (Subgenus Paraplonobia Vainshtein, subgen. nov.).
8 (11). Peritremes broadened at apex.
9 (10). Dorsal bristles spatulate, broadened towards apex, which is rounded. None of pv bristles converted to an acanthoid . . . . . echinopsili Vainshtein, sp. nov.
10 (9). Dorsal bristles narrowly fusiform or aciculate, apically acute. One of pv bristles converted into an acanthoid. . myops Pr. and Bak., 1955.
11 (8). Peritremes apically not broadened (= Mesotetranychus herniariae Bagd., 1954). . . . . herniariae (Bagd., 1954).
12 (1). Empodium padlike, bearing a pair of chetoids. (Subgenus Anaplonobia Vainshtein, subgen. nov.).
13 (14). Dorsal bristles aciculate, coarsely fringed, equal in length to distance between their rows, set on tubercles. Chetoids of empodium slender. . . . . calame Pr. and Bak., 1955.
14 (13). Dorsal bristles fusiform, fringed, considerably shorter than distance between their rows, not set on

tubercles; chetoids of empodium broad at base, forming a group seemingly stuck together at apices. . . . . acharis Pr. and Bak., 1955.

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AIR-CATCH OF INSECTS AS A METHOD OF STUDYING THE ENTOMOFAUNA OF VAST TERRITORIES

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Faunal investigations of insects in the USSR are of the greatest theoretical and practical interest. Control methods are worked out on the basis of an accurate knowledge of the pest species present and their biology and ecology.

Aviation may be of definite use in many cases in faunistic investigations of territories, particularly those which are difficult of access, when used in parallel with terrestrial methods.

It must be remembered that thousands of slow propeller craft of the types AN-2, YAK-12, PO-2 and others are traversing the skies at low altitudes over many unknown and inaccessible areas during the entire insect season, both day and night.

For instance, by early spring, during April and May, the Civil Air Fleet is involved in the fertilization and chemical supplementation of collective and state farm fields, while during the summer months control measures are being directed against agricultural pest blood-sucking Diptera, and rodents, often involving flights at altitudes of only 5—10 meters (Gol'tsov [1958]). In such cases the take-off areas for the planes are clearings near fields, pastures, forest clearings, and so forth.

Depending on the nature of the work, the planes fly in early morning, during the day, or in the evening at times when the air layer over the ground contains an enormous number of different insects, including pest insects, blood-suckers, and vectors of infectious diseases (especially over pastures). Planes of the health, postal, and forest aviation services also spend much time in the air during the insect season. Furthermore, the basic form of transportation in Siberia and the Far East — areas where the faunal composition of insects has been studied least — is now aviation.

Equipping airplanes with special trap mechanisms for insects would facilitate study of the entomofauna of many areas, all the more so if it is remembered that these collections could be carried out simultaneously with the fulfilment of the planes' primary mission.

In foreign literature, some papers by Perry A. Glick [1957] have been devoted to the problem of the utilization of airplanes for collecting insects. For catching insects he used a mechanism especially mounted under the wings — a drum containing five frames with fine-mesh screens which were smeared with a sticky substance. Using this mechanism this author was able to collect a large quantity of insects, numbering thousands of specimens, over the course of many years of work using planes especially set aside for this purpose.

Although the author referred favorably to the construction of his trap, the results of working with air traps of our own construction lead us to believe that even at air speeds of 80—100 km per hour the insects hitting against Glick's metallic screens or the frame of our trap are seriously damaged and become unsuitable for determination.

It should be pointed out that in the USSR no work has been done on collecting insects by traps installed on airplanes (Reikhard [1941]).

In the spring of 1958, during aerial spraying work in the control of blood-sucking flies in one of the central regions of the RSFSR, successful practical tests were carried out on an entomological air trap of our own construction mounted on an AN-2 airplane (Fig. 1).

In spite of the early spring timing and unfavorable meteorological conditions, a considerable amount of entomolological material was collected by the trap. Thus, during flights at 80—100 m altitude at a speed of 1—4 m/sec, air temperature of -2 deg C to +5 deg C, and relative humidity of 87—90%, an average of 50 to 80 undamaged insects fell into the collecting jar of the trap for each 60-kilometer flight. A total of 211 specimens were collected by the air trap after three flights; these included Diptera of the families Tendipedidae, Fungivoridae, and Ephydridae, beetles of the families Staphylinidae and Scarabaeidae, Homoptera of the families Psyllidae and Aphididae, spiders, etc.

The air trap was mounted on the wings of the plane in three locations: at the crossing of the brace wires, on a ring at the biplane strut, and at the anchoring attachment (Fig. 2). During the taxiing and flying of the plane the trap was firmly held in its original position by its fastenings. With each take-off and landing of the plane the trap made two gigantic sweeps. The length of each of these sweeps was about 500 m. The height of the sweep, and consequently of the flow of air passing through

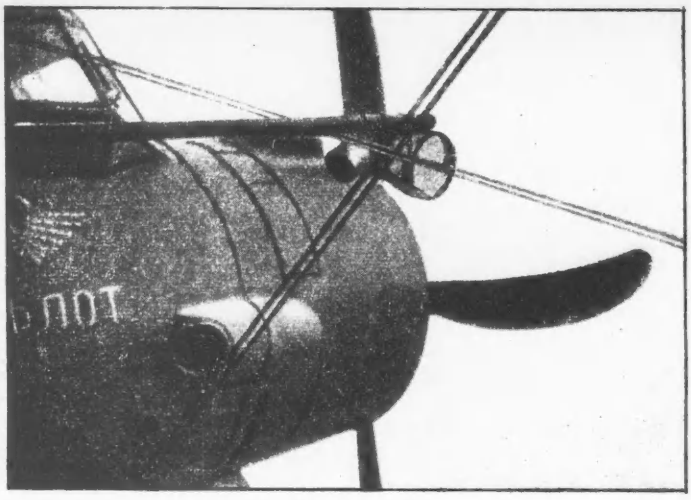

Fig. 1.

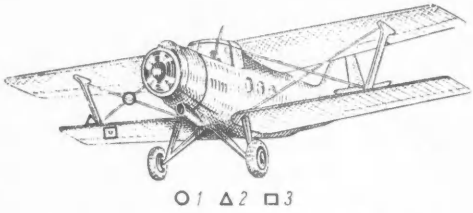

Fig. 2. Entomological air trap. The positions of its attachment on the AN-2 airplane are: 1) at the crossing of the brace wires, 2) on a ring at the biplane strut, and 3) on the anchoring attachment.

the trap, varied from 25 m (the maximum height of the take-off distance) to 1—2 m (the height of the position of attachment of the trap on the wings of the plane).

In construction the air trap consists of a cone truncated at both ends (Fig. 3, 8), made of wire screening with a 1 × 1 mm mesh, and soldered inside a framework of six strong steel braces (1) and three flat rings (2). The hindmost ring of the framework (3) is threaded on the inside in order that the collecting jar (4) may be screwed in. Holes (5) are provided at various places on the frame of the trap for fastening it in different ways to the wings of the plane. For instance, a hole (6) is provided for mounting the air trap to the anchoring attachment of the plane by means of a nut and bolt. The remaining holes (5) are for attachment by means of soft wire and so forth to the brace-wire crossings (Fig.1) and to a ring at the biplane strut which holds the brace wires (Fig.2).

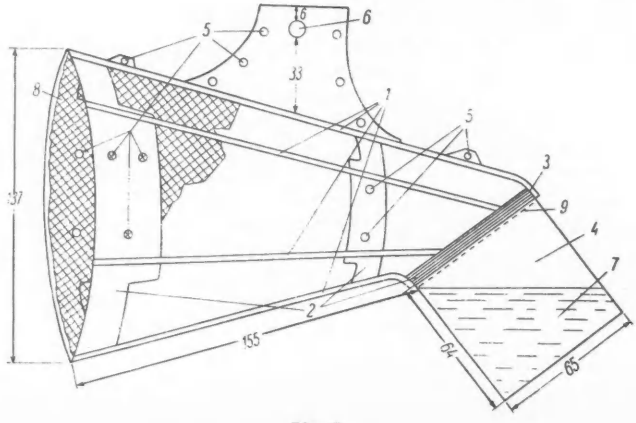

Fig. 3.

The principle of the effectiveness of the air trap is that the so-called collecting jar, screwed in to the narrow hind end of the cone, places in the path of the air stream passing through the screen framework a special liquid "buffer" which prevents the deformation of the insects falling into the trap.

The vertical diameter of the entrance opening of the air trap is 137 mm, of which the upper 87 mm approximately make up the "free zone" through which extend the lines of unimpeded flight by the insects, that is to say, the lines which will lead directly to the "soft cushion" of buffering fluid and not to the hard metal screen. In practice we used glycerin as a buffer, since this fully met the requirements of viscosity, adequate fluidity, and good solubility in water and other solvents, which allowed rapid and easy extraction of the insects and their subsequent preparation.

Anyone in the plane's crew could attach the air trap in two or three minutes without much difficulty.

The results of our work have demonstrated that the aerial trapping method provides a means of collecting insects which occur in the air at altitudes of tens or hundreds of meters above the earth's surface so that they are undamaged and suitable for determination of species.

The simplicity of construction, cheapness, and ease of preparation of the air trap in any departmental workshop ensures its easy installment when necessary on any slow propeller-driven airplane.

Brief instructions to the crew of the plane with a statement of rules for utilizing the trap (locations and means for attaching it to the plane, how to pour out the buffer fluid with its insect contents into a dish, methods for packing them, etc.) would bring about a quicker introduction of the trap into practical use.

SUMMARY

1. The aerial method of trapping insects with the use of an entomological air trap enables one to collect insects easily at any altitude over large expanses and in areas which are difficult or impossible of access.

2. The aerial method of trapping insects enables one to collect insects which soar high up in the atmosphere.

3. The aerial method of trapping insects enables one to determine the altitude of migration of individual species of insects.

4. The buffer fluid enables one to obtain trapped insects in a form suitable for special study.

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THE 75TH ANNIVERSARY OF A. N. KIRICHENKO

M. M. Loginova

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September 9, 1959 marked the 75th anniversary of the birth of one of the oldest research workers in the Zoological Institute of the Academy of Sciences USSR, the Head of the Hemiptera Department, Doctor of Biological Sciences, Prof. Aleksandr Nikolaevich Kirichenko.

Aleksandr Kirichenko was born on September 9, 1884, in the town of Berdyansk (now Osipenko, Zaporozhe Region) into a family of people's teachers. His childhood and youth were passed in the Crimea, in the town of Kerch. In 1903 he finished at Kerch gymnasium. By this time he was already an accomplished naturalist and an ardent excursionist. Ranging over the whole peninsula, he amassed a large and valuable collection of Crimean insects, the first specimens of which he has preserved from his boyhood. The love of nature, of observing the life of the insect world and of collecting insects developed in Aleksandr Kirichenko at a very early age and led to his enrollment in the Department of Natural Sciences of Kharkov University (1903). In 1904 he moved to St. Petersburg and entered the Department of Natural Sciences of the Physico-Mathematical Faculty of St. Petersburg University.

In his student years he undertook his first long expeditions [Alai Range, Pamirs(1905)]and began his scientific work on the collections of the Zoological Museum of the Academy of Sciences.

Aleksandr Kirichenko entered the Zoological Museum (now the Zoological Institute of the Academy of Sciences, USSR) as a civilian in October, 1907, and in 1915 he became a staff zoologist at the museum. From that time his whole life, and all his scientific and public work have been linked with this institution.

For two years he was assistant to N. Ya. Kuznetsov, and in view of this his first published work dealt with the geographical distribution of the butterfly Argynnis eugenia Ev. (1908). During these years, however, he spent all his free time working through his Crimean specimens of Hemiptera-Heteroptera, and this work was completed with the publication of the first three parts of "The Hemipteran Fauna of the Crimea" in 1908, 1910 and 1912 (the last 6 parts were published in the period up to 1952).

His personal bent and close association with the outstanding Russian entomologists Vasilii Fedorovich Oshanin and Vasilii Evgrafovich Yakovlev finally settled his scientific interests. He devoted his life to a thorough study of the systematics, biology and zoogeography of an economically important group of insects — the Hemiptera-Heteroptera of our own and neighboring countries.

During 52 years of work in the Zoological Institute, Akeksandr Kirichenko built up an exceptionally rich collection of Hemiptera (more than 2100 standard insect cabinets) of world-wide scientific value, and the greater part of which was collected by his own hands during his numerous expeditions throughout our country and beyond its frontiers. It is a model of museum preservation of entomological material for any institution of this nature.

In his first years of service in the Zoological Museum he undertook expeditions to remote, little-known and inaccessible desert and mountainous regions of Central Asia (Alai and Trans-Alai Ranges); Pamirs (1908); Talysh, (1909); Western Tien Shan (1910); Southern Bukhara (1912); the Caucasus and Northern Iran (1909, 1914) at the request of the Academy of Sciences and the Russian Entomological and Geographical Societies. These expeditions, as also all the subsequent ones greatly extended our knowledge of our country's fauna as a whole (he never confined himself to the study of his favorite group; his general collections of insects, arthropods and other animals were very large and diverse), and gave him material for subsequent research over many years.

After the Great October Revolution, his scientific work became much more extensive, and went far beyond the sphere of the institute's work.

In 1919-1922 he worked as a lecturer in the Applied Zoology Department of the Kamennoostrovskii Agricultural Institute. In 1920-1923 he led excursions to the Sablinsk field station of Petrograd Political Education Center. From 1926 to 1930 he worked as senior specialist in the Entomology Division of the State Institute of Experimental Agronomy (now the All-Union Institute of Plant Protection, Lenin All-Union Academy of Agricultural Sciences).

With the reorganization of the Museum as the Zoological Institute, Aleksandr Kirichenko took on himself the duty of Head of the Division of Terrestrial Invertebrates and for eleven year (1930-1941), right up to the Great Patriotic War, he directed the scientific activity of the greatest team of entomologists in the country in one of its leading institutes.

In the difficult war years, over a period of 16 months (1941-1942), he honorably discharged his duty as Deputy Director, and later as Acting Director, of the Zoological Institute. The preservation of the building itself, its very valuable collections and in part its personnel, too, were

largely due to his vitality and persevering work, as he was able to organize continuous scientific work during the siege of Leningrad, and the subsequent evacuation of the Institute to Tadzhikistan.

An excellent field worker and organizer, Aleksandr Kirichenko indefatigably carried out research on the fauna of the country, undertaking expeditions into different corners, and often heading the work of zoological sections and expeditions. He was in Dagestan and North Ossetia in 1925, in Mongolia in 1926, in Dagestan again in 1927, in mountainous Ingushetia and on Fergana Range in Central Asia, and in Ussuri Province in 1928. Over a long period of years he studied the Heteroptera of the Crimea (1900-1937), the Caucasus (1901-1905, 1934-1949) and Groki Province (1939). During the war, being evacuated with the institute to Stalinabad, he carried out research on the Hemiptera of Tadzhikistan (1942-1944), and he continued this work at L. Iskander-Kul' in 1947, and in the Pamirs in 1948. In 1949, as a member of a large Zoological Institute expedition he took part in investigations of the insect fauna of the Ural shelterbelt zone. At the age of 66 years he completed an expedition to distant L. Baikal (1950).

His very rich personal experience and encylopedic knowledge of the literature have provided the basis for his fundamental regional summaries of the Heteroptera of several regions of the country (the Crimea, Caucasus, Central Russia, Central Asia, the Far East), his monographs on individual genera and families, and papers dealing with questions of the taxonomy and zoogeography of Hemiptera. Aleksandr Kirichenko's pen is responsible for more than 110 scientific works, a large number of reviews and several popular-science publications.

Aleksandr Kirichenko's contribution to our knowledge of the Hemiptera-Heteroptera of the eastern Palaearctic is inestimable. For him scientific studies are inseparable from the needs of practice. The interests of applied entomology are served by his keys, especially the "Hemiptera-Heteroptera of the European USSR" [1951], which is, in fact, an exhaustive source-book not only on questions of faunistics but also on the morphology, anatomy and classification of the group, as well as being a bibliographic manual of the literature on it.

Aleksandr Kirichenko has taken part in the majority of collective works of the Zoological Institute. He wrote the chapters on Hemiptera in Vol. I of "Freshwater Life of the USSR" [1940], Vols. I-IV of "Animal World of the USSR" [1936, 1948, 1950 and 1953], in the manual "Forest Pests" [1955], and others.

The educational value of his work has been immense. In this connection we must first mention the key "Hemiptera" [1923], which he compiled in cooperation with V.L. Bianki and which has been widely adopted in the work of higher educational institutions during his own lifetime, and the "Instructions for Collecting Hemiptera and the Study of Local Fauna" [1932]. His recently published work "Methods of Collecting Hemiptera-Heteroptera and the Study of Local Fauna" (1957) is a popular account of the knowledge and personal experience of this investigator-naturalist and is much more comprehensive than its modest title implies; this book is indispensable for any young research worker or student interested in the fauna of our country.

For his fundamental works on the fauna and geographical distribution of Hemiptera-Heteroptera he was awarded the degree of Doctor of Biological Sciences in 1934, and in 1939 he was accorded the rank of Professor of Entomology.

A substantial and no less meritable aspect of his activity was his self-denying work on the creation of the library of the All-Union Entomological Society, a collection which is now the most extensive entomological library in the country. As a member of the Society since 1907, he has been in charge as scientific librarian from 1915 up till the present, and right up till 1949 he was the sole worker in it. Without regard for the time involved and with the boundless help of his wife, Evgeniya Mikhailovna, he has compiled the library catalog, and almost doubled the stock of books.

The history of the All-Union Entomological Society during the last 50 years is inextricably linked with his work. His labor on the creation of this remarkable book collection will assist the scientific work of several generations of Soviet entomologists. There is probably no member of the AES who did not know him personally and who has not turned to him for advice and help on questions of entomology, geography, bibliography or the history of Russian entomological research. The All-Union Entomological Society, which commemorates its hundredth anniversary in January, 1960, is pround to count Aleksandr Kirichenko as one of the oldest of its Honored Members.

An outstanding expert on the Hemiptera-Heteroptera and one of the leading entomologists of our country, Aleksandr Kirichenko is a recognized authority in the scientific world. A sympathetic person, generously sharing his vast knowlege, capable of guiding without prompting (this has always been the experience of the writer as a student and worker in his department), he has a great number of disciples — from eminent scholars to youngsters embarking on their scientific careers.

The deep gratitude of his fellow men was expressed in the very numerous congratulations which he received from institutes and individual scientists, at home and abroad, on the day of the 50th anniversary of his splendid service in the Zoological Institute, which was celebrated by the Academic Council of the Zoological Institute in December, 1957.

The head of the Hemiptera Department, a scientist uniting a love of nature and scientific writings with a love of literature and music, a just and good man, Aleksandr Kirichenko is always surrounded by comrades in work and young people studying under him.

For his many years of scientific and public activity he has received several government awards — the Order

of Lenin (1953), the Order of the Labor Red Banner(1944), the medals "For the Defense of Leningrad" (1944) and "For Valorous Work in the Great Patriotic War 1941-1945" (1946), as well as an honorary diploma of the Supreme Soviet of the Tadzhik SSR; in addition, he has several times received acknowledgment and awards from the directorship of the Zoological Institute.

INTERNATIONAL SYMPOSIUM ON THE ONTOGENETIC DEVELOPMENT OF INSECTS

D. M. Shteinberg

Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 1, pp. 233-237, January-March, 1960

A Symposium on the Ontogenetic Development of Insects was held in Prague during September 3-7, 1959. Scientists from 18 countries took part in the work of the symposium, and these included about 100 participants from Czechoslovakia, 13 from the USSR, 11 from Poland, seven each from France, England and the German Democratic Republic, four from Holland, three from Bulgaria, two each from Hungary and Denmark, and one each from Switzerland, Norway, German Federal Republic, Finland, Rumania, India, Pakistan and Australia.

The symposium was opened by Prof. Jan Obenberger, Corresponding Member of the Czechoslovak Academy of Sciences and Head of its Entomology Laboratory; Academician I. Malek, Secretary of the Biological Division of the Czechoslovak Academy of Sciences made a speech of welcome to the participants in the symposium.

The scientific papers at the symposium were divided among 5 topics: "Morphology of Insect Development" — two sessions, "Physiology of Insect Development" — two sessions, "Seasonal Periodicity of Development" — two sessions, "Role of Biotic Factors in Insect Development" — one session, and "Role of Abiotic Factors in Insect Development" — one session. There were 78 papers in all; moreover, some of the scheduled papers were not heard owing to the nonattendance of individual scientists. Since the agenda of each session was overloaded with a very large number of papers the opportunities for their discussion were limited and such discussion was mainly carried out during the intervals. Only one special discussion — on the role of the corpora allata in insect development — was arranged.

There were 15 papers on the first topic "Morphology of Insect Development". These could be classed in three groups; general questions, dealing with the relation between onto- and phylogenesis; more specific, dealing with the development of individual systems of organs; and questions mainly of technique.

The first, extremely interesting, paper was given by Prof. W. B. Wigglesworth (Cambridge, England), who devoted his address mainly to a question of method — to the employment of a cytochemical method for revealing the primary changes occurring in cells acted on by the molting hormone ecdysone. For this purpose Wigglesworth used an osmium technique to study the mitochondrial apparatus in cells of the epidermis and other tissues, with the aid of the electron microscope. The work which he carried out showed that it was possible to detect the primary changes occurring in cells under the action of ecdysone, these changes being associated with protein metabolism and affecting the distribution and structure of the mitochondria.

A second interesting paper on method was given by I. Nitschmann (Humboldt University, German Democratic Republic). He showed that Zeitraffer microcinematography could also be used for insect eggs; by using this method he succeeded in showing that in dipteran eggs there was a distinct migration of the germ band comparable with blastokinesis in Hemimetabola eggs.

Of the six papers dealing with onto- and phylogenetic interrelationships, five were given by Soviet scientists and one by a Czech scientist. The paper of M. S. Gilyarov (Institute of Animal Morphology, Academy of Sciences, USSR, Moscow) gave a description of different types of fertilization in insects and demonstrated that in soil-dwelling forms there was an evolution of fertilization from the external-internal type, typical of Myriapoda and Apterygota, to true internal fertilization. The paper of A. G. Sharov (Palaeontological Institute, Academy of Sciences, USSR, Moscow) dealth with questions of the origin of complete and incomplete transformation from the more primitive prometaboly and of its traces in the postembryonic development of certain fossil species. The paper of B. B. Rodendorf (Palaeontological Institute, Moscow) was concerned with the importance of the duration of postembryonic development in insect phylogenesis, a feature which determines the special forms of evolution in the larval stages. The interesting paper of E. N. Polivanova (Institute of Animal Morphology, Moscow) was given over to a discussion of organogenesis in different representatives of the Pentatomidae, and it was shown that the features of the subfamily were laid down at any early stage, and the species characters at a later stage. Special attention was given to the development of the dorsal stink glands, a feature of importance for taxonomy. In the paper of D. M. Shteinberg (Zoological Institute, Leningrad) on three experimentally investigated examples — the morphogenetic features of the prothorax in Galleria mellonella, the heteromorphic regeneration of the antennae in Carausius morosus, and the number of ovarioles in Apoidea — it was shown that the potenti-

alities of tissues corresponded to their modes of development in phylogenesis. The paper of V. Novak and K. Slama (Biological Laboratory of the Czechoslovak Academy of Sciences, Prague) raised the question of the correspondence of the pupal stage in Holometabola with the second half of the last nymphal stage in Heminetabola; a particular feature in support of this conclusion was Slama's experimental results for the gas-exchange curve, which had the same V-shaped form in the stages compared.

Of the seven more specific papers four were devoted to the structure and development of the nervous system. G. Richard and G. Gaudin (Rennes University, France) dealt with the development of the brain in some Odonata; H. Jawlowski (Entomological Laboratory of the Polish Academy of Sciences, Lublin) examined the development of stalked bodies in the brain of several Hymenoptera; C. Denis and J. C. Lefeuvre (Rennes University, France) discussed the development of nerve endings in cockroach wings, termite limbs and the mouthparts of dytiscids; L. H. Finlayson (Birmingham University, England) dealt with an experimental study of the trophic function of the nervous system in the development of musculature, particularly during metamorphosis.

V. Landa (Entomological Laboratory of the Czeckoslovak Academy of Sciences, Prague) gave a careful description of spermatogenesis in certain chafers and, by studying the structure of the spermatophores, found that the process of liberation of sperm did not depend on the physiological influence of the female. I. Hrdy (Entomological Laboratory of the Czechoslovak Academy of Sciences, Prague) discussed the development of hemocytes in the blood of the house cricket, while F. Piotrowski (Poznan, Poland) examined the development of the copulatory apparatus in lice.

The second topic of the symposium covered physiological factors in insect development. The papers were grouped mainly around two problems: the role of hormones, and features of metabolism. The greatest attention was given to the neurohormonal regulation of sexual maturation; three papers dealt with this subject. E. Thomsen (Zoological Laboratory, Copenhagen, Denmark), continuing his investigations with Calliphora, showed experimentally that the neurohormone of the neurosecretory cells of the pars intercerebralis in the brain regulated protein synthesis; on extirpation of these cells in adult flies, proteinase was not formed in the gut, even when they were fed intensively, and the eggs did not ripen. J. Strangways-Dixon (Cambridge, England) found that in Calliphora the neurosecretory hormone was necessary only in the period of enhanced protein metabolism of the ripening eggs; the second period of growth of the ovocytes was dominated by carbohydrate metabolism, regulated by the corpora allata. A. S. Johansson (Oslo University, Norway) showed that in the bug Oncopeltus fasciatus the corpora allata do not function and ripe eggs do not develop during fasting or uncongenial conditions of feeding; however, if the nerves innervating the corpora allata are cut the functions of the gland are restored even in conditions of fasting, and the eggs are formed.

M. Gersch (Jena University, German Democratic Republic) furnished further evidence in support of his already-developed theory on the coordinated neurosecretory activity not only of the brain, but of the subesophageal ganglion and the entire nerve chain; when cockroaches were castrated he found the "castration cells" described by B. Scharrer not only in the brain, but in the abdominal ganglia as well.

G. B. Staal (Entomological Laboratory, Wageningen, Holland) examined the relation between the phase differences in the Asiatic and desert locust and the functioning of the corpora allata. By implanting additional glands he obtained green Schistocerca individuals, typical of the solitary phase.

In V. Novak's laboratory (Institute of Biology of the Czechoslovak Academy of Sciences, Prague), a series of studies was carried out to reveal the relation between metamorphosis and the activity of the corpora allata. V. Novak and his colleagues studied a new object — the soldier bug (Pyrrhocoris apterus). E. Červenkova carried out volumetric measurements of the corpora allata and several other internal organs in this species and compared them with its general growth; by implantation of additional corpora allata it was found that at the last nymphal stage a normal quantity of juvenile hormone corresponding to the volume was formed. E. B. Rodendorf-Holmanova took part in a study of the effect of transplantation of corpora allata on the function of the corpora allata of the recipient on the example of Pyrrhocoris, while K. Slama and K. Wening participated in an investigation of the effect of such implantation on gas exchange. This whole group of papers, aimed at further development of the theory of metamorphosis, illustrates the intensive work in progress on this problem in the Czechoslovak Academy of Sciences.

Closely connected with questions of hormonal regulation were the two papers on castes in termites and ants. M. Lüscher (Berne University, Switzerland) showed that in the termite Kalotermes flavicollis the appearance of winged sexual individuals, soldiers, and castes replacing the sexual individuals was determined at the last larval stages in a strictly defined critical period, the determining factor in the development of soldiers being apparently food, while the formation of castes replacing the sexual individuals was regulated by pheromones, i.e., biologically active substances transmitted from individual to individual by contact (old name — exohormones). M. V. Brian (Dorset, England) studied castes in Myrmica and showed what great importance the neurosecretion and the hormones of the corpora allata had in their formation.

The remaining papers on the physiology of insect development covered either general aspects of metabolism or dealt with the role of individual enzymes or other biologically active substances. For instance, V. Janda (Brno University, Czechoslovakia) investigated the metabolism of larval sawflies in relation to their feeding curve, while K. Slama (Prague) studied gas exchange and the activity of cytochrome oxidase and succinic dehydrogenase in the metamorphosis of sawflies, consideration being given to the peculiarities of their diapause. The activity of proteolytic enzymes in Heteroptera was also dealt with in the paper of P. Nuorteva (Helsinki University, Finland).

A series of papers on the biochemistry of the development of Deilephila euphorbiae was given by L. Mochnacka and M. Jezewska, workers in L. Heller's laboratory (Institue of Biochemistry of the Polish Academy of Sciences, Warsaw) and also on phosphatases and esterases in the gut and Malpighian tubules of Galleria mellonella by A. Przelecka (Institute of Biology of the Polish Academy of Sciences, Warsaw) and coauthors. In the paper of C. L'Helias (Gif-sur-Yvette, France) an attempt was made to give a biochemical characterization of neurohumoral activity by studying pyrimido-pyrazine compounds, and by suppressing the activity of the hormone in Pieris brassicae by injection of folic acid.

Of special significance among the other papers on developmental physiology were those of A. K. Voskresenskaya (Institute of Evolutionary Physiology, Leningrad) on the functional development of the neuromuscular system of the flight apparatus in the Asiatic locust during ontogenesis; J. Pospišil (Entomological Laboratory of the Czechoslovak Academy of Sciences, Prague) on the chemotaxes of the imago of Musca domestica L., who found that they could change under the influence of unusual conditions of development of the larva; A. F. O'Farrel (Armidale University, Australia) whose paper was devoted to the special features of regeneration of the limbs of stick insects in relation to the times of surgical interference.

The third topic of the symposium was the discussion of seasonal periodicity of development. The main papers on this topic dealt with questions of photoperiodism; among them, questions of more general significance were raised in the papers of de Wilde, Danilevskii, Müller and Lees.

I. de Wilde (Wageningen, Holland), who previously established a relationship between diapause in the Colorado beetle and the short daylight period [this was confirmed at the symposium in the report of W. Wengorek (Poznan, Poland)] showed that the physiological regulation of the reduced metabolism, the delay of ovogenesis and the distinctive behavior of the beetles were effected through the corpora allata, the response to lowered titer of the hormone being associated with the subcellular level; tissue homogenates under stimulation by active corpora allata showed a marked rise in oxygen consumption. A. S. Danilevskii (Zoological Institute, Academy of Sciences, USSR, Leningrad) devoted his paper to an analysis of the physiological adaptations of geographical races of different species of Lepidoptera; he showed that the photoperiodic reaction changed at different latitudes according to a definite pattern, and this determined the time of onset of diapause and the number of generations; local races differed also in the temperature conditions for reactivation. H. I. Müller (Entomological Department of the Agricultural Academy, Quedlinburg, German Democratic Republic) showed in his paper the importance of the photoperiod for seasonal polymorphism; taking the example of the leafhoppers Euscelis and Stenocranus the speaker showed that the period of daylight affected not only the onset of diapause but led to differences in color and morphology (for instance, the structure of the copulatory apparatus) in different generations. In an interesting paper A. D. Lees (Cambridge, England) analyzed the complex life cycle of the aphid Megoura viciae in relation to photoperiodism and temperature; the effect of these two factors was observed even at the stage of the ovocyte in the maternal organism, the sex depending only on the temperature, but both factors acting on the embryo determined whether sexuparae or egg-laying individuals would develop; at still later stages the presence or absence of wings was decided.

Another paper heard with great interest was that of E. B. Vinogradova (Zoological Institute, Academy of Sciences, USSR, Leningrad) on the role of photoperiodism in the onset of the imaginal diapause in bloodsucking gnats, and the account of its variability in different species, subspecies and geographical populations. The great importance of photoperiodism in the regulation of the life cycle was also demonstrated in the papers of B. Tischler (Kiel University, German Federal Republic) by the example of the bug Ischnodesmus sabuleti, I. Ankersmit (Wageningen, Holland) for Ceuthorrhynchus pleurostigma (but not for the univoltine Ceuthorrhynchus assimilis), and E. Templin (Forestry Institute, Tarandt, German Democratic Republic) for a number of forest pests. R. S. Ushantinskaya (Institute of Animal Morphology, Academy of Sciences, USSR, Moscow) gave a detailed analysis of the biochemical differences between diapausing and nondiapausing papae of the Chinese oak silkworm and showed that they could be detected long before the onset of diapause. Closely related work was performed by V. Novak (Prague) on pupae of Saturnia pavonia L., in which, however, the onset of diapause or its absence was experimentally induced by removal of the brain. I. Hodek and I. Cerkasov (Entomological Laboratory of the Czechoslovak Academy of Sciences, Prague) investigated imaginal diapause in Coccinella septempunctata L. and showed its facultative nature. L. Schoonhoven (Wageningen, Holland) studied the synchronization of diapause in the geometrid Bupalus piniarius L. and its parasitic tachinid Carcelia obesa. A

comprehensive paper on the life cycle of the frit fly Oscinella frit was given by J. R. Le Berre (Central Station of Agricultural Zoology, Versailles, France), who investigated the temperatures at which the different ontogenetic stages could develop.

The fourth topic on the agenda was that of the role of biotic factors in insect development. Of the 12 papers heard, seven were devoted to questions of the relationship of phytophages to their food plants. H. Nolte (Anshersleben, German Democratic Republic) gave a review of the present state of the problem of gall-formation; V. Macko and L. Jasič (Plant Protection Laboratory, Ivankapri Dunaji, Czechoslovakia) examined the food consumption of Hyphantria cunea Drury when the caterpillars were reared under different temperature conditions; A. Pfeffer (Prague University) gave an account of the food relationships of bark beetles with their food plants.

Five papers dealt with aphids: G. Kh. Shaposhnikov (Zoological Institute, Academy of Sciences, USSR, Leningrad) summarized the previously published material on the evolution of life cycles of aphids in the process of adaptation to the life cycles of their hosts; A. Pintera (Phytopathology Laboratory of the Czechoslovak Academy of Sciences, Prague) examined the question of the effect of growth stage of the food plant on the development of aphids, while L. Weismann (Plant Protection Laboratory, Ivankapri Dunaji, Czechoslovakia) studied the effect of osmotic pressure on the distribution of aphids; C. J. Banks (Rothamsted, England) investigated the effect of the ants Lasius niger on the multiplication and development of bean aphids, while I. Hodek (Entomological Laboratory of the Czechoslovak Academy of Sciences, Prague) investigated the possiblity of the ladybirds Coccinella septempunctata L. and Adalia bipunctata L. feeding on different species of aphids.

The papers of M. Stolina (Zvolen, Czechoslovakia) raised some cenotic questions of development; the paper of H. Sander (Ecology Laboratory of the Polish Academy of Sciences, Warsaw) made an analysis of the growth rates of populations of certain storehouse pests in relation to their density.

The fifth topic was concerned with questions of the effect of abiotic factors. I. Krolovič (Plant Protection Laboratory, Ivankapri Dumaji, Czechoslovakia) showed the effect of temperature and humidity on different stages of development of the lucerne gall midge (Contarina medicaginis in relation to its seasonal fluctuations in numbers; similar questions were dealt with in the paper of I. Dlabola (Prague), who investigated the life cycle of the cicada Calligypona pellucida; the ecology of the reindeer warble fly (Oedemagena tarandi L.) was the subject of a paper by K. A. Breev (Zoological Institute, Academy of Sciences, USSR, Leningrad). An interesting paper was that of R. Folliot (Rennes University, France), who studied the life cycle of the primitive gall wasp Xestophanes potentillae and showed that this species forms only one type of gall in northern France, but forms two types in the south — the initial stages of evolution of the complicated life cycle typical of the more specialized gall wasps. A rather special place was occupied by the paper of A. B. Getsova (Zoological Institute, Academy of Sciences, USSR, Leningrad), who reported the results of investigations on the accumulation of various radioisotopes by aquatic insects at different stages of their ontogenetic development.

The symposium was lively and interesting. This was due to its excellent organization of the part of the Czechoslovak Academy of Sciences. In contrast to many other international symposiums arrangements were made for simultaneous translation into all the languages used — Czech, Russian, English, French and German. The staff of the Entomology Laboratory of the Czechoslovak Academy of Sciences — Prof. J. Obenberger, Dr. Landa, Dr. Novak, and others — were specially concerned in the organization of the symposium.

A very useful purpose was served by the visits of the symposium participants to several laboratories — the Entomological Laboratory, the Biological Institute of the Czechoslovak Academy of Sciences, the Plant Protection Institute in the environs of Bratislava, and other centers. There is no doubt that the symposium was of great value in bringing together research workers in the field of insect ontogenesis from different countries, and in bringing to their notice the immediate scientific problems awaiting collective research. The proceedings of the symposium will be published during the first half of 1960.

THE HYMENOPTERA COLLECTION OF O. I. RADOSZKOWSKI

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Octavius Burmeister-Radoszkowski (1820-1895), a Pole by nationality, Founder-Member of the Russian Entomological Society, an Honored Member and Acting President (1867-1880) of the same society, was a military man by education and profession and retired with the rank of Lieutenant-General of the Russian Army. He served in the Horse Artillery and at various times took the courses in higher mathematics, artillery and the course on firearms in the artillery school and in the officers' rifle school (Bogdanov [1888]; Porchinskii [1897]; Essig [1931]).

Radoszkowski was an outstanding entomological taxonomist and a recognized authority in the field of research of the higher Hymenoptera, including the Apoidea. This aspect of his activity brought him greater, more lasting, and wider renown than his military activity (Brockhaus and Éfron [1899]; Essig [1931]).

The period of Radoszkowski's entomological activity coincided with the time when Central Asia was joined to Russia, the time of subjection of the Caucasus and the Far East, and the first comprehensive scientific investigation of these territories. From his entomologist friends, from soldiers (including, probably some of his pupils) and also from exiled Polish investigators in Siberia he often received the first faunistic materials, from which he described many new species of higher Hymenoptera.

Radoszkowski published a total of about 80 works and entomological notes containing a considerable body of knowledge.* For a proper assessment of the historical value of his works we must bear in mind the extremely low level of systematic and phylogenetic research on Hymenoptera at that time, as well as the extremely low level of faunistic research in Russia, and particularly in the territories joined to it. These works are made more important still by the fact that, in spite of the great extent of entomological work during the period which has elapsed since then, the study of the Hymenoptera as an order and the study of the USSR fauna are still very incomplete.

From a present-day viewpoint Radoszkowski was very inadequate and superficial, and sometimes he described new species very carelessly, thus giving rise to many synonyms; some of the species described by him have not been found again, some are not recognized owing to bad descriptions. He correctly "sensed" new genera, but this, however, did not prevent him from describing them very inadequately and erroneously including members of other genera in them. He employed methods of investigation which were advanced for his time — the study of the mouth organs and stinging apparatus (begun in 1872) and the systematic comparative study of the copulatory organs (begun in 1884); the last method was probably adopted from the English investigator E. Saunders, to whose work of 1882 he often referred and whom he probably met during his visit to England. This comparative-systematic and to some extent comparative-morphologic series of works of Radoszkowski, despite some dilettantism, several serious slips, inaccuracies and errors, represents the best of his scientific work. He illustrated his works, especially of this series, with clear, though not always accurate, figures of the copulatory organs and the adjacent sternites; sometimes he described and figured the copulatory organs and sternites of different species under the same name.

All these circumstances make Radoszkowski's particularly valuable collection the only source for determining what the investigator was actually dealing with in a particular case.

His Hymenoptera collection was well known, "it contained many interesting and rare species, and even more types described from abroad and by the deceased himself" (Porchinskii [1897]). On retiring, Radoszkowski brought his collection to Warsaw, and after his death it passed into the hands of his heirs. Part of the Apoidea landed in the Berlin Zoological Museum, where some were later reexamined and redetermined by Friese [1909].

* The list of Radoszkowski's entomological works given by I. A. Porchinskii [1897] was far from complete and numbered only 37 titles. Yet the publications of the Entomological Society alone contain 60 of them (Oshanin [1910]), 47 being devoted entirely to Hymenoptera. Moreover, Porchinskii omitted several works contained in the Bulletin of the Moscow Society of Naturalists (Ballion [1882]; Deinega [1936]) including such an important one as the study of the copulatory organs of sphecids [1891], and others.

Radoszkowski composed a biographic sketch of the conchologist V. E. Lyubomirskii (Bogdanov [1888]). There is no complete bibliography of Radoszkowski's works so far.

After the restoration of Polish independence in 1919 all the rest of the collection was acquired by the Krakow Academy of Sciences and here it was transferred into 102 new large collection cabinets, where it still remains in a good state of preservation under the care of the Krakow Division of the Zoological Institute of the Polish Academy of Sciences; the curator of the collection is Mgr. Miroslawa Dylewska. When the collection was rehoused in 1919, some of it perhaps earlier, all the badly damaged insects were removed; thus these were probably destroyed some of the type specimens of Radoszkowski and other specialists with whom he exchanged material We can surmise that during the period of almost 25 years between the death of Radoszkowski and the transference of his collection to Krakow it suffered a great deal owing to lack of proper attention.

On the mutual request of the Academy of Sciences, USSR and the Academy of Sciences of the Polish People's Republic, the author of the present sketch had the opportunity of visiting Krakow in 1959 and by the kind consent of Prof. T. L. Jaczewski, Corresponding Member of the Polish Academy of Sciences and Director of the Zoological Institute, Academician J. Stach, head of its Krakow Division, and of Mgr. Dylewska, was able to study Radoszkowski's collection of Apoidea over a period of three weeks, and to become familiar with the collection as a whole.

First of all it was found that the collection includes a great deal of material from the collection of Eduard Eversmann. Besides the Eversmann material, the collection contains material collected by I. Porchinskii and B. Dybowski, according to the labels, as well as of many other persons, known from Radoszkowski's works but not indicated in the corresponding labels. Radoszkowski himself apparently collected little. The collection mainly contains material from Poland, Belorussia, the Ukraine (Volyn', Crimea), Orenburg Region, the Caucasus, Transcaucasus, Central Asia, Western and Eastern Siberia, Iran, as well as a few specimens from Western Europe, North Africa and other localities. Besides the type specimens of Radoszkowski himself and of Eversmann, the collection contains types and paratypes of André, Dours, Hartig, Giraud, Mayr, F. Morawitz, Pérez, Sichel and others.

In the years following Radoszkowski's death, individual genera of Hymenoptera in the collection were subjected to reexamination. For instance, P. Blüthgen completely revised the material relating to the genera Halictus, Nomioides and Sphecodes, J. Noskiewicz — Colletes, J. Alfken — the genera Chalicodoma and Megachile, P. Lozinskii — the genus Nomada, J. de Beaumont — Psenulus (Mimesa) and Tachyspex, and others. All this material was accurately redetermined and labeled, including several type specimens. In a number of cases the results of these revisions were not published, and it is presumed that the manuscript of J. Alfken, who died during the war, was lost. The accurately labeled material enabled Polish investigators to restore the lost specimens and to describe the species outlined earlier. Besides this, M. Dylewska is now occupied with a revision of the material relating to the genus Bombus.

A more thorough examination of the Apoidea showed that very often specimens designated in the collections as types of Radoszkowski's species were not so, for instance Pseudomelecta baerii and Andrena oulskii; in a number of cases it was found that types were not denoted as such and had been assigned to other species, for instance Crocisa sibirica and Paracoelioxys barrei. Some species were lost, for instance the types of Andrena transcaspica, Lithurgus maximus, Anthidium eversmanni, Osmia ashabadensis, O. euchreiformis, O. thoracica, several species of Crocisa — altaica, caucasica, mervensis, africana, abyssinica, amboinensis, bimaculata, and others. An investigation showed that the types of Cilissa amurensis, C. media, C. minor and C. thoracica (designated in the collection as C. seuli Rad., nom. nud.) were species of Andrena, and the type of Tetralonia morawitzi (without Radoszkowski's identification label) was a species of Proxylocopa; the description of this species agrees completely with a specimen of Proxylocopa. In cases where some of the specimens of a particular species of Radoszkowski were in the Berlin Zoological Museum, there sometimes arose a disagreement with Friese's supposition, and hence a further reinvestigation is required.

The author of the present article examined 347 species of bees, including 108 species described by Radoszkowski, for some of the species a provisional synonymy was found, for several others corresponding specimens were brought for comparison from the material of the Zoological Institute, Academy of Sciences, USSR, and the species in question, particularly those described by Radoszkowski from Central Asia could then be recognized and their synonymy established. Among the examined species of bees 86 entirely or in part originated from E. Eversmann's collection, including the types or cotypes of the following species described by Eversmann: Hylaeus ciliatus, H. laevigatus, H. patellatus, Andrena incisa, A. interrupta, A. scita, Panurginus labiatus, Ammobatoides abdominalis, A. hirsutus, Rophites canus, Dasypoda braccata, Anthidium auripes, A. dissectum, A. floripetum, A. integrum, A. regulare, A. reptans, A. senile, A. sibiricum, Osmia scita, O. hamata, O. fulva, Nomada lutea, N. rubricosa, N. dubia N. rubra, N. aberrans, N. pastoralis, Biastes schottii, B. fasciatus, Epeoloides fulva, Tetralonia mediocris, Eucera coarctata, Anthophora albifrons, A. atricilla, A. dubia, A. fulva, A. fulvipes, A. fulvitarsis, A. lepida, A. pedata, A. quadricincta, A. segnis, A. vetula, and Pseudomelecta diacantha.

In his works on bees Radoszkowski mentioned more than once that he possessed this or that species of Eversmann, and specified this on each occasion. On re-describing Anthophora fulva Ev., he recorded that he possessed Eversmann's collection (Radoszkowski [1884]);

this could have referred only to the bees alone and, from a consideration of Eversmann's material preserved at that time in the Russian Entomological Society, only to some of them. At the same time Radoszkowski's collection contains, besides the already-mentioned Apoidea material from Eversmann's collection, all the specimens of Braconidae, Proctotrupoidea, Chalcidoidea, a large part of the Ichneumonidae and some of the Mutillidae, Pompilidae, and Chrysididae. It is quite understandable that Radoszkowski, who had no special interest in many of these groups of Hymenoptera, had no occasion to record anywhere the fate of the corresponding parts of Eversmann's collection.

Eversmann's collection is very important since it contains the first faunistic materials of more than a century ago from the southeast European USSR and Siberia. Eversmann, in spite of the assertion of his biographer V. Geptner [1940], did not usually indicate in his works the exact localities of his species, and when he received accurately labeled material from Sarepta or Kyakhta he merely recorded that the first was found in Saratov Province, and the second in "terris transuralensibus". In view of this it is obvious why Eversmann's collection is of special importance as the only material for revealing the exact locality of the species described and mentioned by him.

Eversmann's collection contained 50,420 specimens, including 9,254 specimens of Hymenoptera (Geptner [1940]). After Eversmann's death (1860) the Lepidoptera, and a little later the Orthoptera, Hemiptera and some of the Hymenoptera were acquired by the Russian Entomological Society (Semenov and Keppen [1865]). In 1908-1916 these collections were presented to the Zoological Museum of the Academy of Sciences (Nanosov [1909; 1911]). In the report of the Zoological Museum for 1911 it was noted that "recently the Museum had been very preoccupied with obtaining the entire, very valuable insect collection left after Eversmann's death and scattered among various institutions and private collectors. The Museum has now succeeded in collecting all of it, with the exception of the beetles, which were sold abroad" (Nanosov [1912, p. 3]); the same information was repeated in a world list of entomological collections (Horn [1926, p. 44]). This, however, does not correspond to fact. We may surmise that a considerable portion of the Hymenoptera collection was acquired by Radoszkowski from Eversmann's heirs in the early 60's of the last century and thus, like the beetles, eventually left the country. We also know that Radoszkowski carried on a correspondence with Eversmann earlier and obtained from him material for investigation.

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[Biological Sciences]

Abbreviation*	Journal*	Translation
Agrobiol.	Agrobiologiya	Agrobiology
Akusherstvo i Ginekol.	Akusherstvo i Ginekologiya	Obstetrics and Gynecology
Antibiotiki	Antibiotiki	Antibiotics
Aptechnoe Delo	Aptechnoe Delo	Pharmaceutical Transactions
Arkh. Anat. Gistol. i Émbriol.	Arkhiv Anatomii Gistologii i Émbriologii	Archives of Antomy, Histology, and Embryology
Arkh. Biol. Nauk SSSR	Arkhiv Biologicheskikh Nauk SSSR	Archives of Biological Science USSR
Arkh. Patol.	Arkhiv Patologii	Archives of Pathology
Biofizika	Biofizika	Biophysics
Biokhimiya	Biokhimiya	Biochemistry
Biokhim. Plodov i Ovoshchei	Biokhimiya Plodov i Ovoshchei	Biochemistry of Fruits and Vegetables
Bot. Zhur.	Botanicheskii Zhurnal	Journal of Botany
Byull. Éksptl. Biol. i Med.	Byulleten Éksperimentalnoi Biologii i Meditsiny	Bulletin of Experimental Biology and Medicine
Byull. Moskov. Obshchestva Ispytatelei Prirody, Otdel Biol.	Byulleten Moskovskogo Obshchestva Ispytatelei Prirody, Otdel Biologicheskii	Bulletin of the Moscow Naturalists Society, Division of Biology
Doklady Akad. Nauk SSSR	Doklady Akademii Nauk SSSR	Proceedings of the Academy of Sciences USSR
Éksptl. Khirurg.	Éksperimentalnaya Khirurgiya	Experimental Surgery
Farmakol. i Toksikol.	Farmakologiya i Toksikologiya	Pharmacology and Toxicology
Farmatsiya	Farmatsiya	Pharmacy
Fiziol. Rastenii	Fiziologiya Rastenii	Plant Physiology
Fiziol. Zhur. SSSR	Fiziologicheskii Zhurnal SSSR im. I. M. Sechenova	I. M. Sechenov Physiology Journal USSR
Gigiena i Sanit.	Gigiena i Sanitariya	Hygiene and Sanitation
Izvest. Akad. Nauk SSSR, Ser. Biol.	Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya	Bulletin of the Academy of Sciences USSR, Biology Series
Izvest. Tikhookeanskogo N. I. Inst. Rybnogo Khoz. i Okeanog.	Investiya Tikhookeanskogo N. I. Instituta Rybnogo Khozyaistva i Okeanografii	Bulletin of the Pacific Ocean Scientific Institute of Fisheries and Oceanography
Khirurgiya	Khirurgiya	Surgery
Klin. Med.	Klinicheskaya Meditsina	Clinical Medicine
Lab. Delo	Laboratornoe Delo (po Voprosam Meditsiny)	Laboratory Work (on Medical Problems)
Med. Parazitol.	Meditsinskaya Parazitologiya i Parazitarnye Bolezni	Medical Parasitology and Parasitic Diseases
Med. Radiol.	Meditsinskaya Radiologiya	Medical Radiology
Med. Zhur. Ukrain.	Medichnii Zhurnal Ukrainskii	Ukrainian Medical Journal
Mikrobiologiya	Mikrobiologiya	Microbiology
Mikrobiol. Zhur.	Mikrobiologichnii Zhurnal	Microbiology Journal
Nevropatol., Psikhyat. i Psikhogig.	Nevropatologiya, Psikhyatriya i Psikhogigiena	Neuropathology, Psychiatry and Psychohygiene
Ortoped., Travmatol. i Protez.	Ortopediya, Travmatologiya i Protezirovanie	Orthopedics, Traumatology and Prosthetics
Parazitol. Sbornik	Parazitologicheskii Sbornik	Parasitology Collection
Pediatriya	Pediatriya	Pediatrics
Pochvovedenie	Pochvovedenie	Soil Science
Priroda	Priroda	Nature
Problemy Éndokrinol. i Gormonoterap.	Problemy Endokrinologii i Gormonoterapii	Problems of Endocrinology and Hormone Therapy
Problemy Gematol.	Problemy Gematologii i Perelivaniya Krovi	Problems of Hematology and Blood Transfusion
Problemy Tuberk.	Problemy Tuberkuleza	Problems of Tuberculosis
Sovet. Med.	Sovetskaya Meditsina	Soviet Medicine
Sovet. Vrachebny Zhur.	Sovetskii Vrachebnyi Zhurnal	Soviet Physicians Journal
Stomatologiya	Stomatologiya	Stomatology

* BRITISH-AMERICAN TRANSLITERATION SYSTEM.

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Abbreviation	Journal	Translation
Terap. Arkh.	Terapevticheskii Arkhiv	Therapeutic Archives
Trudy Gelmint. Lab.	Trudy Gelmintologicheskoi Laboratoriya	Transactions of the Helminthology Laboratory
Trudy Inst. Genet.	Trudy Instituta Genetiki	Transactions of the Institute of Genetics
Trudy Inst. Gidrobiol.	Trudy Instituta Gidrobiologiya	Transactions of the Institute of Hydrobiology
Trudy Inst. Mikrobiol.	Trudy Instituta Mikrobiologiya	Transactions of the Institute of Microbiology
Trudy Inst. Okean.	Trudy Instituta Okeanologiya, Akademii Nauk SSSR	Transactions of the Institute of Oceanology, Academy of Sciences, USSR
Trudy Leningrad Obshchestva Estestvoisp.	Trudy Leningrad Obshchestva Estestvoispytatelei	Transactions of the Leningrad Society of Naturalists
Trudy Vsesoyuz. Gidrobiol. Obshchestva	Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva	Transactions of the All-Union Hydrobiological Society
Trudy Vsesoyuz. Inst. Eksptl. Med.	Trudy Vsesoyuznogo Instituta Eksperimentalnoi Meditsiny	Transactions of the All-Union Institute of Experimental Medicine
Ukrain. Biokhim. Zhur.	Ukrainskii Biokhimichnii Zhurnal	Ukrainian Biochemical Journal
Urologiya	Urologiya	Urology
Uspekhi Biokhimiya	Uspekhi Biokhimiya	Progress in Biochemistry
Uspekhi Sovremennoi Biol.	Uspekhi Sovremennoi Biologiya	Progress in Contemporary Biology
Vestnik Akad. Med. Nauk SSSR	Vestnik Akademii Meditsinskikh Nauk SSSR	Bulletin of the Academy of Medical Science USSR
Vestnik Khirurg. im. Grekova	Vestnik Khirurgii imeni Grekova	Grekov Bulletin of Surgery
Vestnik Leningrad. Univ. Ser. Biol.	Vestnik Leningradskogo Universiteta, Seriya Biologii	Journal of the Leningrad Univ., Biology Series
Vestnik Moskov. Univ., Ser. Biol. i Pochvov.	Vestnik Moskovskogo Universitera, Seriya Biologii i Pochvovedeniya	Bulletin of the Moscow University, Biology and Soil Science Series
Vestnik Oftalmol.	Vestnik Oftalmologii	Bulletin of Ophthalmology
Vestnik Oto-rino-laringol.	Vestnik Oto-rino-laringologiya	Bulletin of Otorhinolaryngology
Vestnik Rentgenol. i Radiol.	Vestnik Rentgenologii i Radiologii	Bulletin of Roentgenology and Radiology
Vestnik Venerol. i Dermatol.	Vestnik Venerologii i Dermatologii	Bulletin of Venereology and Dermatology
Veterinariya	Veterinariya	Veterinary Science
Vinodelie i Vinogradarstvo	Vinodelie i Vinogradarstvo SSSR	Wine-Making and Viticulture
Voprosy Klin.	Voprosy Klinicheskie	Clinical Problems
Voprosy Med. Khim.	Voprosy Meditsinskoi Khimii	Problems of Medical Chemistry
Voprosy Med. Virusol.	Voprosy Meditsinskoi Virusologii	Problems of Medical Virology
Voprosy Neirokhirurg.	Voprosy Neirokhirugii	Problems of Neurosurgery
Voprosy Onkol.	Voprosy Onkologii	Problems of Oncology
Voprosy Pitaniya	Voprosy Pitaniya	Problems of Nutrition
Voprosy Psikhologii	Voprosy Psikhologii	Problems of Psychology
VoprosyVirusologii	Voprosy Virusologii	Problems of Virology
Vrachebnoe Delo	Vrachebnoe Delo	Medical Profession
Zav. Lab.	Zavodskaya Laboratoriya	Factory Laboratory
Zhur. Mikrobiol., Epidemiol. i Immunobiol.	Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii	Journal of Microbiology, Epidemiology, and Immunobiology
Zhur. Nevropatol. i Psikhiat.	Zhurnal Nevropatologii i Psikhiatrii imeni S. S. Korsakov	S. S. Korsakov Journal of Neuropathology and Psychiatry
Zhur. Obshchei Biol.	Zhurnal Obshchei Biologiya	Journal of General Biology
Zhur. Vysshei Nerv. Deyatel.	Zhurnal Vysshei Nervnoi Deyatelnosti imeni I. P. Pavlova	I. P. Pavlov Journal of Higher Nervous Activity
Zool. Zhur.	Zoologicheskii Zhurnal	Journal of Zoology

ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN RUSSIAN BIO-SCIENCES LITERATURE

Abbreviation (Transliterated)	Significance
AMN SSSR	Academy of Medical Sciences, USSR
AN SSSR	Academy of Sciences, USSR
BIN	Biological Institute, Botanical Institute
FTI	Institute of Physiotherapy
GONTI	State United Sci-Tech Press
GOST	All Union State Standard
GRRRI	State Roentgenology, Radiology, and Cancer Institute
GTTI	State Technical and Theoretical Literature Press
GU	State University
I Kh N	Scientific Research Institute of Surgical Neuropathology
IL (IIL)	Foreign Literature Press
IONKh	Inst. Gen. and Inorganic Chemistry (N. S. Kurnakov)
IP	Soil Science Inst. (Acad. Sci. USSR)
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd.	Press
LEM	Laboratory for experimental morphogenesis
LENDVI	Leningrad Inst. of Dermatology and Venereology
LEO	Laboratory of Experimental Zoology
LIKhT	Leningrad Surgical Institute for Tuberculosis and Bone and Joint Diseases
LIPZ	Leningrad Inst. for Study of Occupational Diseases
LIPK	Leningrad Blood Transfusion Institute
Medgiz	State Medical Literature Press
MOPISh	Moscow Society of Apiculture and Sericulture
MVI	Moscow Veterinary Institute
MZdrav	Ministry of Health
MZI	Moscow Zootechnical Institute
LOKhO	Leningrad Society of Orthopedic Surgeons
NIIZ	Scientific Research Institute of Zoology
NINKhI	Scientific Research Institute of Neurosurgery
NIU	Scientific Institute for Fertilizers
NIUIF	Scientific Research Institute of Fertilizers and Insecticides
NIVI	Veterinary Scientific Research Institute
ONTI	United Sci. Tech. Press
OTI	Division of Technical Information
RBO	Russian Botanical Society
ROP	Russian Society of Pathologists
SANIIRI	Central Asia Scientific Research Institute of Irrigation
SANIISh	Central Asia Scientific Research Institute of Sericulture
TsNII	All-Union Central Scientific Research Institute
TsNTL	Central Scientific and Technical Laboratory
VASKhNIL	All-Union Academy of Agricultural Sciences
VIG	All-Union Institute of Helminthology
VIEM	All-Union Institute of Experimental Medicine
VIR	All-Union Institute of Plant Cultivation
VIUAA	All-Union Institute of Fertilizers, Soil Science, and Agricultural Engineering
VIZR	All-Union Institute of Medical and Pharmaceutical Herbs
VNIRO	All-Union Scientific Institute of Fishing and Oceanography
ZIN	Zoological Inst. (Acad. Sci. USSR)

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us. - Publisher.